MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 38 JUNE, 1932 Number 10

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For Small Holes

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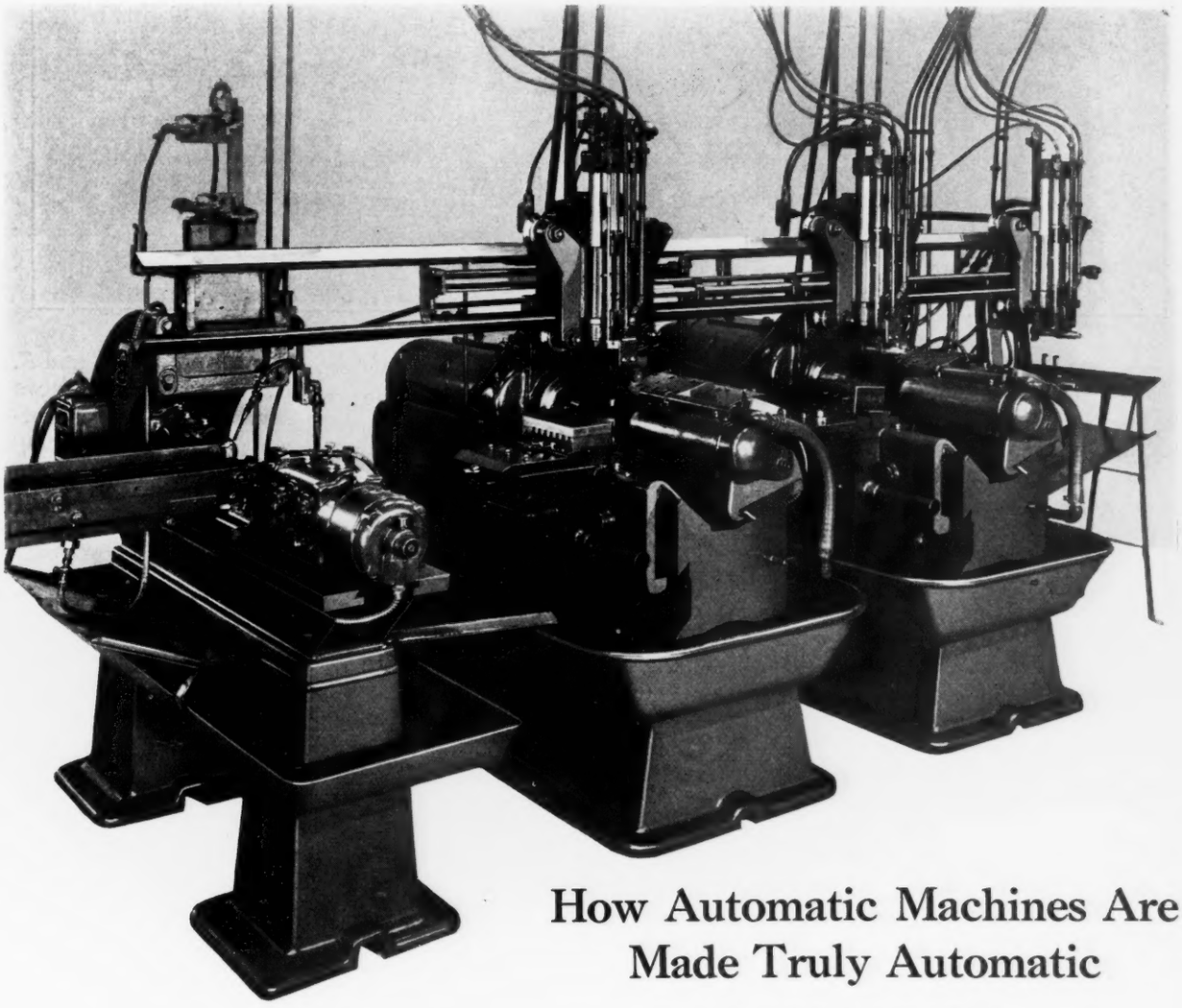
HEALD

MACHINERY

Volume 38 NEW YORK, JUNE, 1932 Number 10

Automatic Loaders for Groups of Machines



How Automatic Machines Are Made Truly Automatic

By CHARLES O. HERB

WHAT would our metropolitan newspapers be like today if type still had to be set by hand as in Benjamin Franklin's time? How would our farms be able to feed the millions living in towns and cities if farmers still used the agricultural implements of the pioneer days? Would it be possible for this vast country to function satisfactorily without modern transportation facilities? A moment's consideration of these questions will make apparent the great importance of automatic machinery in present-day conditions of living. Automatic machines have reduced costs in every branch of industry to such an extent that many of the things that were once considered luxuries have now become everyday necessities to the average man.

Wherever large production is required in the metal-working industry, the majority of machines operate automatically. Conveyors are universally used to carry work to and from the different machines without human effort. However, with the exception of automatic screw machines, compara-

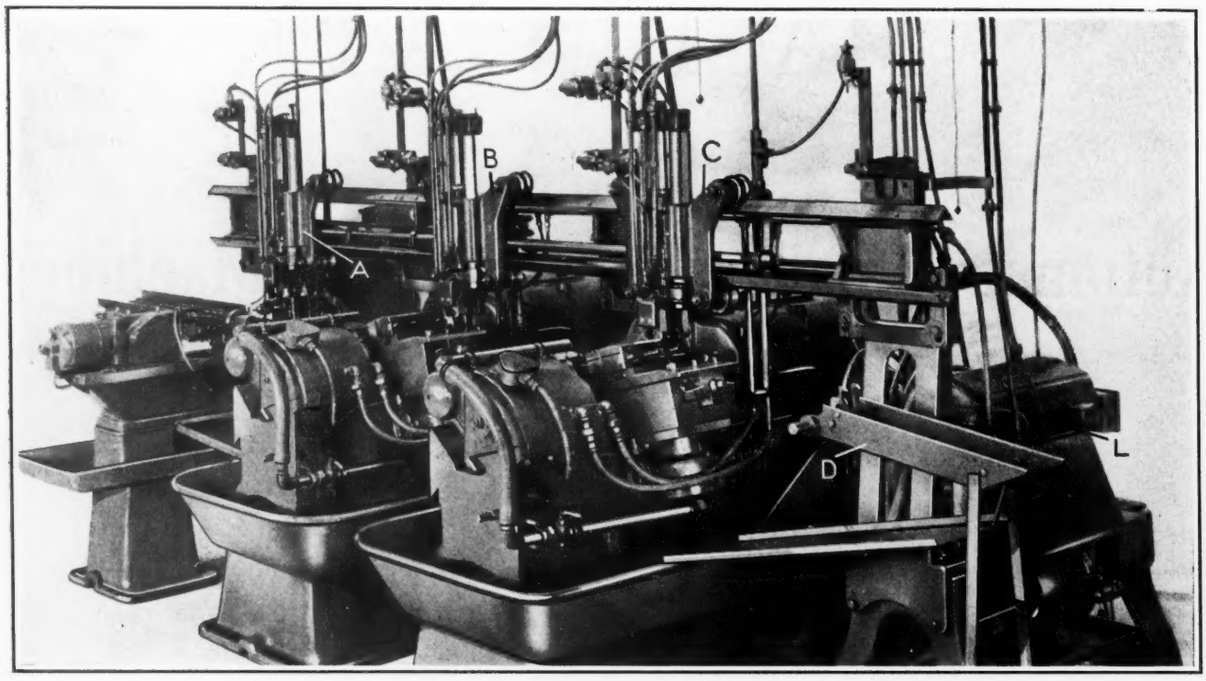


Fig. 1. Automatic Loaders Require Only a Few Seconds for Loading Automobile Sector Shafts Simultaneously into These Three Machines

tively few machine tools load themselves automatically. Loading and unloading, in many cases, is the most expensive item in the manufacturing procedure.

During the last few years, the Seneca Falls Machine Co., Seneca Falls, N. Y., has applied automatic work loading and unloading devices to individual machines of different types. This concern has now gone a step farther and developed equipment for simultaneously loading work into groups of machines and removing the pieces that have been machined. The equipment is adapted for handling a variety of parts, especially work that can be held between centers or in chucks. It is covered by patents issued and pending.

The heading illustration, as well as Figs. 1 and 2, shows this equipment installed at the New Castle, Ind., plant of the Chrysler Corporation. In this case, the equipment simultaneously loads and unloads three machines used, respectively, for centering, rough turning and facing, and finish turning and facing automobile steering-gear sector shafts. The rough forgings, approximately 8 inches long, are delivered by a conveyor to the automatic loader of the centering machine, which is seen at the left in Fig. 2. Loading heads *A*, *B*, and *C*, Fig. 1, transfer the parts from each machine to the next, finally delivering the completely finished part to chute *D* at the right-hand end of the installation, which leads to a conveyor.

The rough sector-shaft forgings roll into notches at the left-hand end of the two stationary bars *E* and *F*, Fig. 2. At predetermined intervals, the second pair of notched bars *G* and *H* is raised sufficiently to lift all the pieces of work above the notches of bars *E* and *F*. Bars *G* and *H* then move forward a distance corresponding to the spacing of the notches, drop down again, and return to their starting position. During the cycle, these bars advance each sector-shaft forging one notch along bars *E* and *F*. When the leading sector-shaft forging reaches the centering spindles, it is lifted into stationary V-supports *J*, approximately in line with the spindles, which are then in their withdrawn positions. Bars *G* and *H* are operated hydraulically.

The Loading Units of the Three Machines Operate in Synchronism

Loading of the centering machine, as just described, occurs immediately before the three loading heads *A*, *B*, and *C* release partly finished pieces to the headstock and tailstock centers of the next two machines and deliver a completed piece to the chute *D*. When the loading heads have released the parts, the transfer fingers rise to their highest positions and the heads move toward the left into the positions shown in Fig. 1.

Then while the fingers of heads *B* and *C* remain in the raised position, the fingers of head *A* come down and pass over the rough forging which lies in the V-supports *J*. Immediately, a valve operates the hydraulic cylinder *K*, and this unit advances equalizing clamps to close the transfer fingers firmly on the work. The vees in the fingers cause the work to rise accurately into line with the centering spindles. When the clamps close, they trip the automatic drill heads of the centering machine, causing them to advance and center the work from both ends, after which they again withdraw.

The transfer fingers of head *A* remain down until the rough turning and facing operation in the second machine, and the finish turning and facing operation in the third machine, have been completed, even though the centering operation is much shorter than the others. When all the operations are completed and the machines have stopped, the transfer fingers of heads *B* and *C* are brought into position around the parts in the second and third machines.

The fingers of all three heads are then clamped on the work by means of hydraulic cylinders on the heads themselves, after which the clamps of the centering machine and the tailstocks of the turning and facing lathes are withdrawn to free the pieces from the machines proper. All three finger units now rise, after which the loading heads travel to the right, above the successive machines and into the positions shown in the heading illustration.

The finger units of all the heads next move down, and the tailstock centers of the two turning and facing lathes advance to support the work pieces while the part held by the third head at the right is allowed to drop into chute *D*. All three finger units then again rise, and as they reach their high positions, the motors of the two lathes start running for the turning and facing operations. The heads now move to the left again, completing the cycle.

Fig. 4 shows diagrammatically the construction of the loading heads and work-transferring fingers. An important feature of the rough turning and facing operation is that seven tools are employed for the turning alone, which reduces the horizontal movement of the front tool carriage to only 1 3/8 inches. This greatly reduces the cutting time of the operation. The front tool carriage of the finish turning and facing lathe moves 2 1/16 inches.

Electric Switches Insure Complete Safety

The movements of all three heads along the rails are accomplished by connecting the heads to one long rod that is moved back and forth by a piston in a hydraulic cylinder seen over the middle machine in the heading illustration. Thus all movements of the loading heads and their work-transfer fingers, of the centering machine loader and clamps, and of the tailstocks on the turning and facing lathes are accomplished by hydraulic equipment. Each movement is absolutely controlled through the use of electric switches and solenoids. It is impossible for any part of the loading heads or of the machines to start functioning until every other part that makes a movement beforehand has completed that movement. All switches for similar functions are in series, so that, for example, the switches that control the tailstocks on the lathes or the switches that control similar movements of the three loading heads must all be closed or else none can operate.

In one operation, a center drill broke off and remained in the hole. When the piece of work reached the rough turning and facing lathe, the broken-off drill prevented the full advance of the tailstock on that machine,

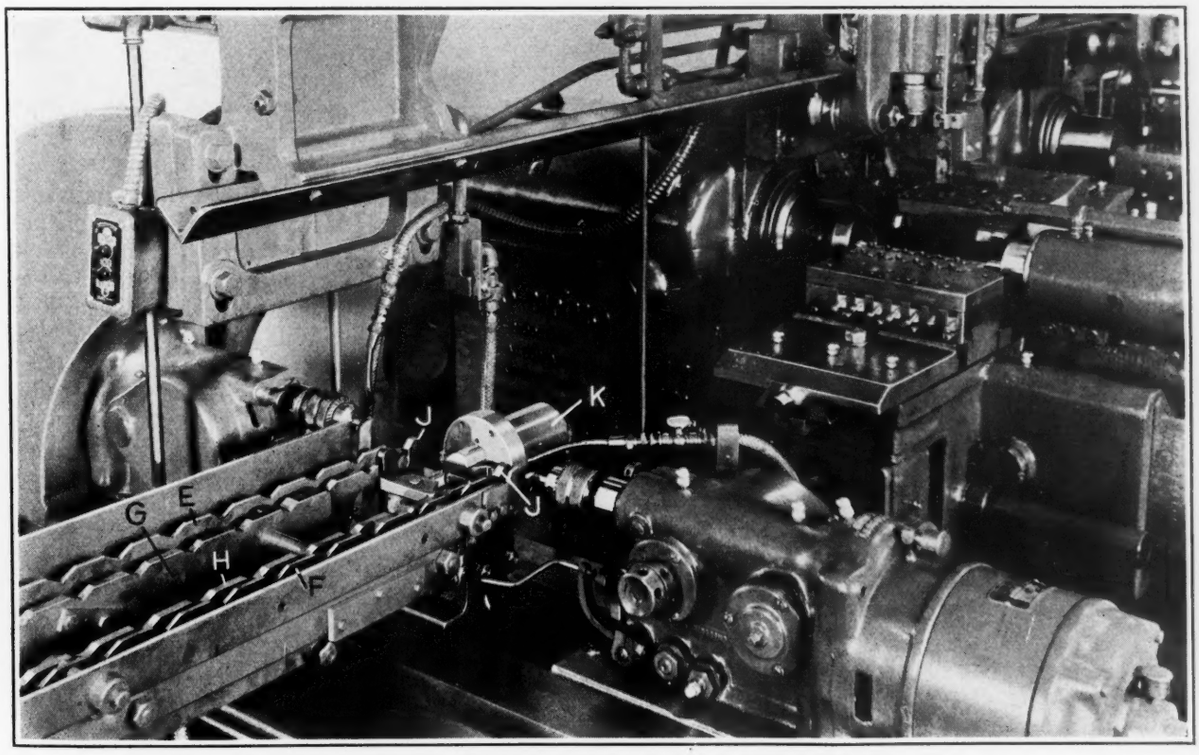


Fig. 2. The Automatic Loader of the Centering Machine Operates in Synchronism with the Heads that Load the Turning and Facing Lathes

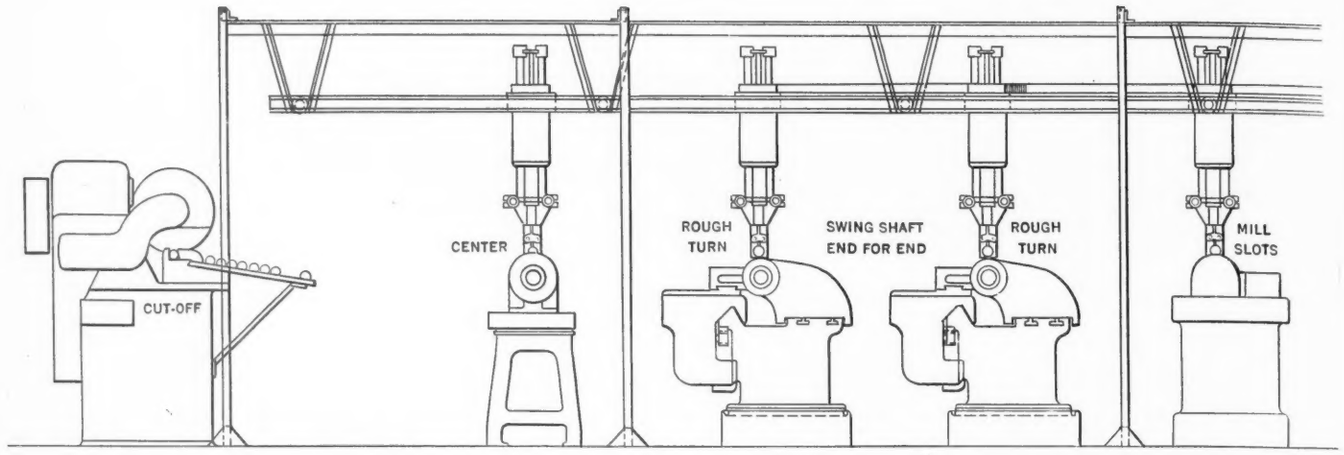


Fig. 3. Hydraulically Operated Loading Equipment Designed to Serve Nine Machines Simultaneously

and although the tailstock of the finish turning and facing machine was able to complete its movement, none of the transfer fingers withdrew from the work pieces and none of the machines could start running. At any time during the cycle of operations, the entire equipment can be stopped immediately by merely pulling a cord that controls all the solenoids.

One pump supplies pressure for all the hydraulic cylinders on the automatic loaders and on the machines. The hydraulic control unit may be seen at the right-hand end of the equipment in Fig. 1. All the valves are contained in box *L*. The compartment directly beneath serves as the oil reservoir, while the pump and motor are attached to the under side of that compartment.

Loading arrangements of the type described are also applicable to long rows of similar machines, provided the machines can be loaded from overhead. Fig. 3 shows a proposed lay-out for machining armature shafts without a person touching them after they have been cut from the bar stock.

The Operations Performed by the Group of Machines in Fig. 3

Nine operations are proposed for the shaft in the following sequence: Cut off, center both ends, rough-turn one end, rough-turn the opposite end, mill slots, finish-turn one end, finish-turn the opposite end, grind one end, and grind the opposite end. The shaft will then be deposited by the extreme right-hand loading head on a chute that leads to a conveyor.

In this sequence, the armature shafts must be swung end for end between the rough-turning operations, the finish-turning operations, and the grinding operations. Also, after each piece has been lowered into line with the centers of the machines, it is necessary for the work-transfer fingers of the loading heads to move horizontally a short distance into line with the machine centers, in order to enter one end of each part into a chuck. Conversely, when the operation is finished, the work pieces must be moved horizontally in the opposite direction to withdraw them from the chucks before they can be lifted vertically.

All these head movements can be ac-

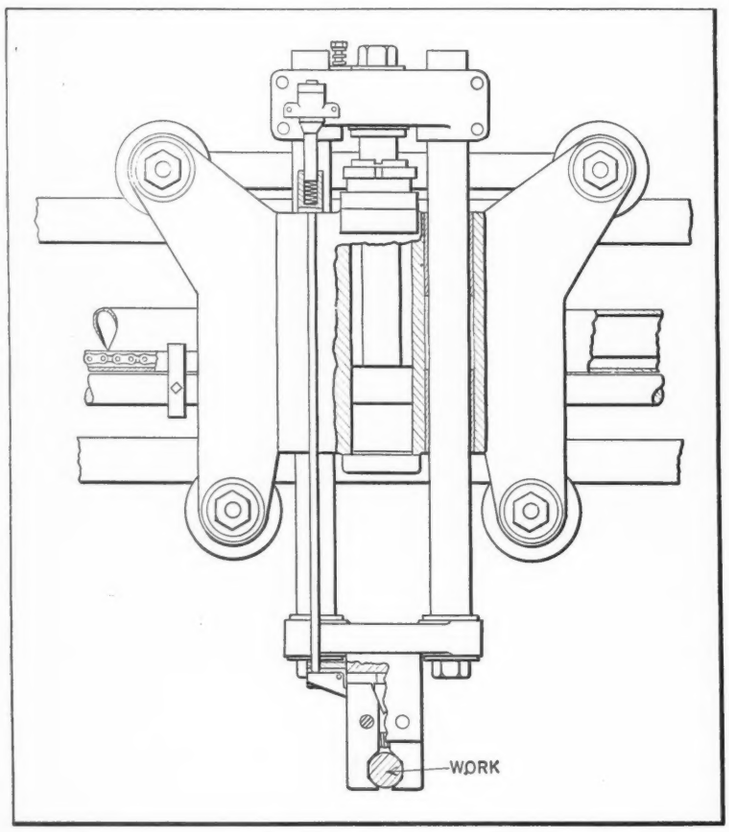
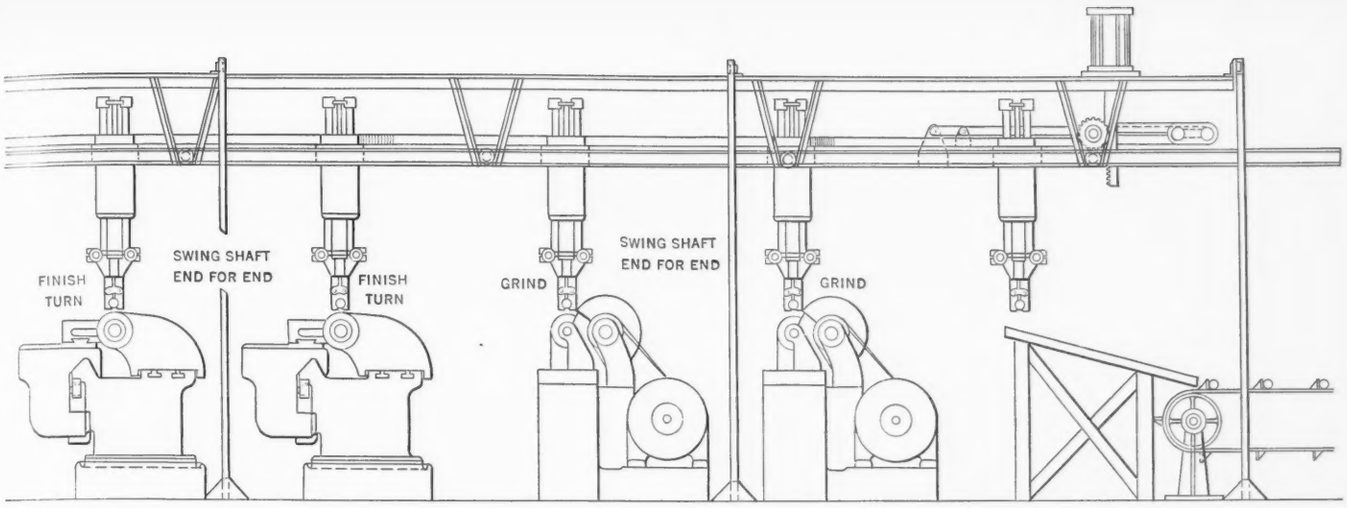


Fig. 4. One of the Heads Used in Loading Automobile Steering Sector Shafts into the Three Machines Shown in Fig. 1

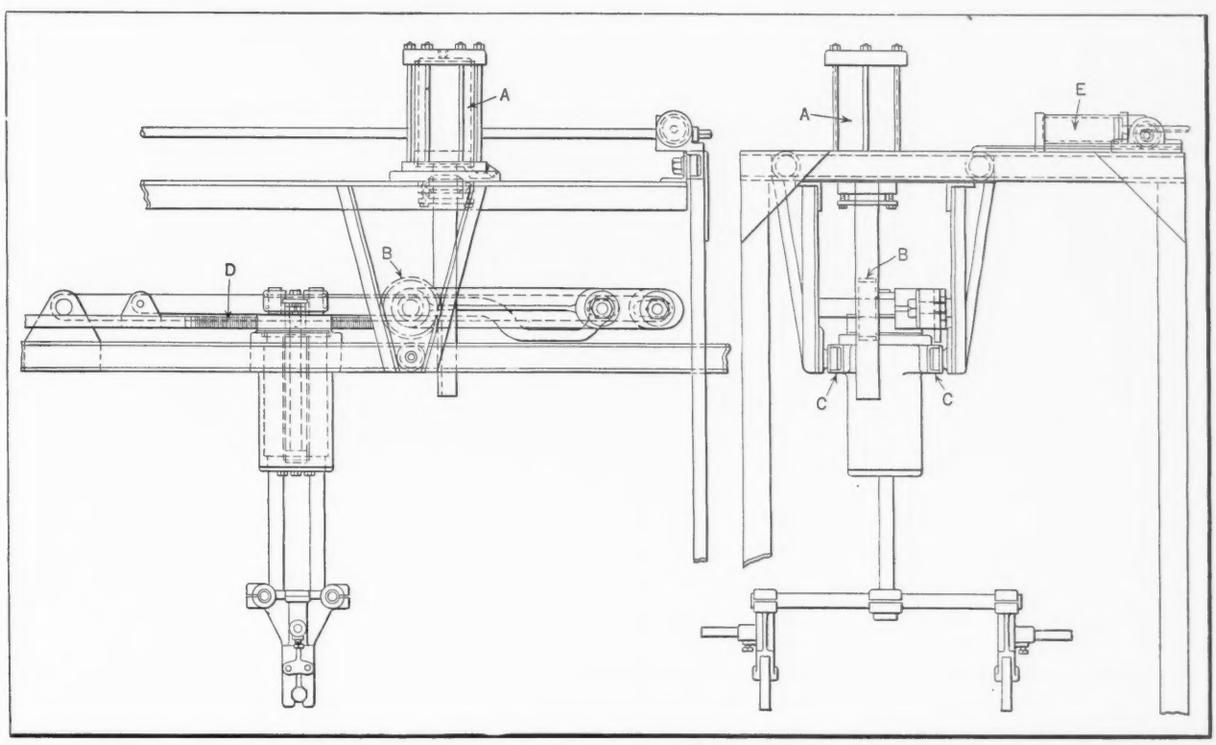


Provision is Made for Turning the Work Pieces End for End between Three of the Operations

complished by means of equipment such as illustrated diagrammatically in Fig. 5. At one end of the work-loading equipment there is shown a hydraulic cylinder *A* having a piston-rod with rack teeth that engage pinion *B*. The pinion is mounted on a shaft having a crank that operates two connecting-rods. One of these connecting-rods actuates channel irons *C* to which all the loading heads are attached, and thus imparts the necessary movement for carrying the heads back and forth between the respective machines.

The second connecting-rod operates a bar having rack teeth *D* in three places to engage a gear on each of the heads that must turn the work end for end, as already mentioned. Thus, while the heads are moved from one machine to the other, the rack teeth are also moved horizontally at a different rate so as to swivel the head transfer fingers and the work through 180 degrees. The in-and-out movements of the transfer fingers when they are in line with the machine centers are accomplished by means of the hydraulic cylinder *E*, which supplies power for actuating a rack connected to the structural carriage that supports all the loading heads. The transfer fingers of this equipment are also opened and closed by clamps actuated through hydraulic equipment on the individual heads.

Fig. 5. Equipment that Turns Work End for End, and Imparts In-and-Out Movements for Inserting the Pieces into the Chucks and Removing Them



Automatic Loaders Can be Designed to Meet Individual Needs

Automatic loaders can also be supplied for machines installed end for end rather than side by side. They have been designed, too, for feeding machines in which the work does not revolve, as, for instance, milling machines. With certain parts, such as brake-drums, it may often be desired to tip the piece 90 degrees in a vertical plane to position it for drilling or tapping. Equipment has also been developed for meeting such requirements. Automatic loaders can be operated hydraulically, electrically, or mechanically.

Automatic Loaders Replace the Eyes as Well as the Hands of Operators

Mechanical loading arrangements must be provided with safety devices, in order to guard against danger, either to the machines or to the loaders themselves, in the case of broken tools or similar difficulties. Thus, to be successful, automatic loading equipment must replace the eyes as well as the hands of operators. Safe operation can be insured by the use of electrical equipment as described or by means of cams.

Since the introduction of tungsten- and tantalum-carbide tools, the time lost in reloading machines has become increasingly important, because this time has become an even greater percentage of the total time than before. It has been shown that, with automatic loading equipment, the time can be reduced to a few seconds in certain types of operations. Another advantage of automatic loaders is that the reloading time remains constant hour after hour, because the loader does not become "tired" toward the end of the day and slow up its speed, as an operator necessarily does. Also, time is not lost by stopping the machine every once in a while during the day for brief rests. An operator naturally becomes fatigued, because even with light pieces such as automobile steering sector shafts, he will lift about 4800 pounds per eight-hour day.

In Addition to Reducing Costs, Automatic Loaders Prevent Injuries to Workmen

There is still another big advantage derived from the use of automatic loaders—the elimination of injuries to workmen. Obviously, the equipment has its widest application on machines of the lathe type, and it is of interest to note, from statistics gathered by the National Council on Compensation Insurance, that over 10 per cent of all machine shop accidents severe enough to cause fatality or to require compensation for a year or more occur in the operation of lathes. Ninety per cent of these lathe accidents occur at the point of operation, 50 per cent being due to chips striking the eyes of workmen. The other severe accidents are the result of operators being struck or caught by the work, tools, or other moving parts.

Automatic loaders could be applied to the handling of big parts, as well as small or medium-sized pieces, but, of course, they effect the greatest economies when the time of operation is brief and frequent loading is necessary.

The Foundation and Not the Machine May be Responsible for Excessive Vibration

By W. F. SCHAPHORST

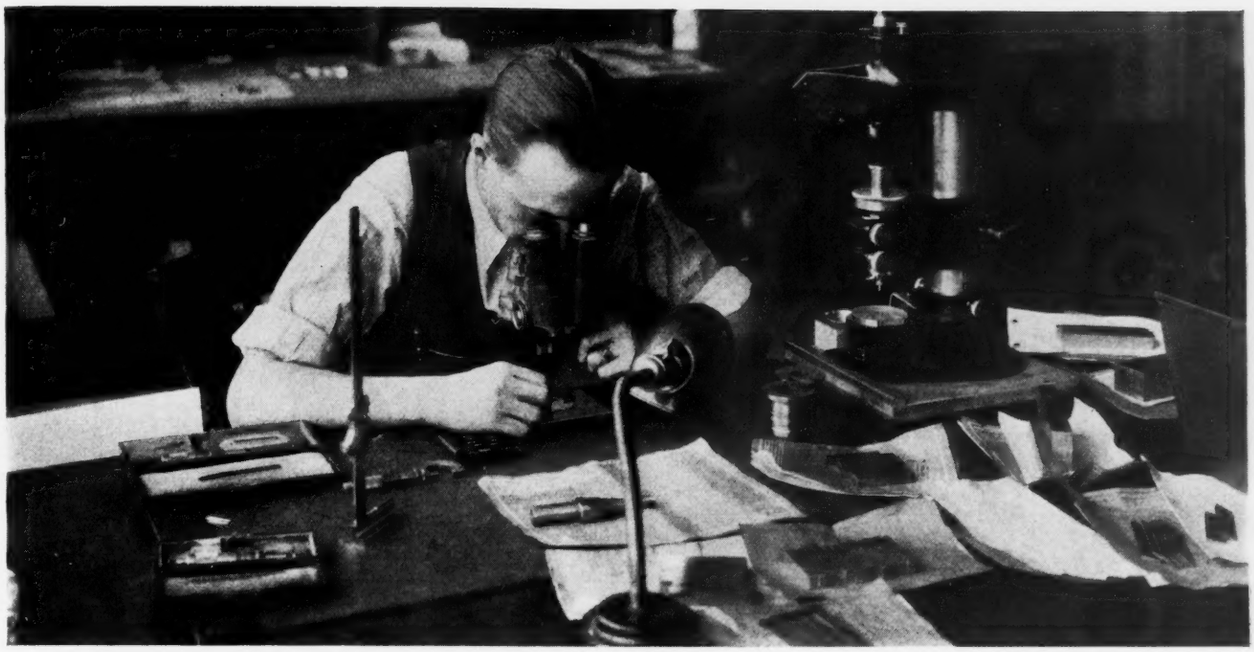
Vibration is perceptible to a greater or less degree in practically every machine. Perfect balancing is impossible, and all machines carrying high-speed rotating or reciprocating parts vibrate. A foundation is usually necessary to counterbalance or absorb the vibrations. However, all objects, including foundations, have what is known as a "natural period of vibration." Of course, a large massive foundation has a lower period of vibration than a small one.

It is conceivable that a foundation placed under a machine may have the same period of vibration as the machine. Under such conditions, the vibration will be increased rather than diminished. In fact, vibrations transmitted to the foundation by the machine may cause the vibrations of the two objects to become extremely violent. It is clear, therefore, that the period of vibration of a foundation must never be the same as that of the machine it supports. Machines are sometimes blamed for annoying noises and vibrations when the actual trouble lies in the foundation.

One of the most effective modern methods for eliminating vibration and noise is to isolate the machine from the building or from the ground by means of a strong resilient material. Natural cork is usually employed for this purpose. Cork has a natural period of vibration which is invariably different from that of any machine. It remains elastic during a long period of years—that is, it does not gradually yield under pressure like most other materials—and will not warp, swell, or shrink. Sometimes the cork is placed directly under the machine on top of the foundation, and at other times the foundation itself rests on the cork.

* * *

The exports of airplane accessories during the year 1931 were 30 per cent greater than in any previous year.



How Carboloy Tools are Made

Though Much has been Published on the Use of Carboloy Tools, Comparatively Little is Known Regarding the Production of the Material Itself

By ADAM MacKENZIE
Carboloy Company, Inc., Detroit, Mich.

THE tungsten used in Carboloy tools is manufactured directly from the ore in the Carboloy Co.'s own plant. The tungsten ore is purchased in such quantities that one lot will last for a period of years. Each lot is thoroughly intermixed and the process is adjusted, if necessary, to take care of any differences in these lots. This eliminates fluctuations caused by variables in the raw material.

To the tungsten is added carbon. The two elements are thoroughly mixed and then introduced into a furnace where the tungsten and carbon combine to make tungsten carbide. To the tungsten carbide is added the binder or binders, with perhaps other carbides, depending on the grade of material being made. The mixtures are then ball-milled for a considerable period of time. The mixing of the metallic powders is so controlled that the various grades produced will meet definite requirements in the metal-cutting and wire-drawing fields.

Pressing the Powdered Material into Blanks

After the blending or ball-milling operation, the loose powder is pressed to the shape desired by placing it in hardened steel molds and subjecting it to high pressures in a hydraulic press. The material is pressed into a great variety of forms and shapes by using molds especially designed to meet the customer's requirements. This method, supplemented by the practice of further forming the metal directly after the semi-sintering process (at which time the metal can be readily shaped), eliminates a large amount of subsequent grinding or shaping of the fully hardened material.

The time saved by pressing the powdered materials to shape is well illustrated in the production of Carboloy wire-drawing dies. These dies are pressed down with a radius, double-angle approach and any hole size down to 0.015 inch in a variety of nib sizes. When preformed in this manner, a minimum amount of rough-drilling is necessary to shape the die after it is hardened.

Semi-Sintering the Pressed Material

"Semi-sintering" is the term used to define the preliminary treating or hardening of Carboloy, which constitutes a prerequisite to economic shaping. Semi-sintering is effected by subjecting the pressed Carboloy to a temperature of about 800 to 900 degrees C. in a non-oxidizing atmosphere. This treatment greatly increases the strength of the pressed Carboloy and enables it to be safely and conveniently handled while being cut, formed, shaped, or turned.

Machining or Shaping the Semi-Sintered Material

Carboloy that has been properly semi-sintered is quite workable and can successfully undergo many operations. It can be cut with a saw or cutting

Fig. 1. (Left) After the Powdered Tungsten Carbide and Binding Material for Making Carboloy Tips have been Mixed in a Ball Mill, Hydraulic Presses Equipped with Hardened Steel Dies Form it into Blanks, such as are Illustrated in Fig. 3

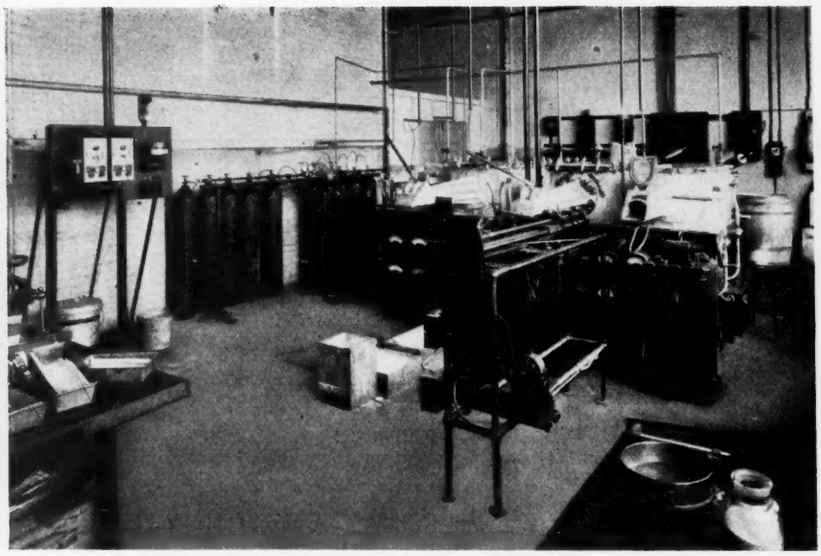


Fig. 2. (Right) The Carboloy Tool Blanks are Subjected to a "Semi-sintering," or Initial Treating, Process, after which They are Cut to Shape. They are then Given a Final Hardening or "Sintering" in These Accurately Controlled Furnaces

wheel, ground or shaped with an abrasive or grinding wheel, worked with a file or emery cloth, turned on a lathe, and drilled or machined by practically any means employed for metal working. The workability of semi-sintered Carboloy may be compared with chalk. Unlike chalk, however, Carboloy, in the semi-sintered state, is quite abrasive. For this reason, Carboloy tools are used for forming operations wherever possible.

Because of the ease with which semi-sintered Carboloy can be shaped, as compared with the difficulty that would be encountered in shaping after hardening, it is more economical to form angles or shapes on the tips before the final sintering operation. The changes that take place in the Carboloy when it is hardened are reliably consistent, and calculations can be made to allow for shrinkage, so that the hardened tip will be accurate within a few thousandths of an inch of the finished size. Consequently, all form-tool and special tips are made as near to finished specifications as possible.

The correct angles and radii are easily put on standard tool tips during the tip-shaping process. While it is desirable to lessen the amount of finish-grinding by forming close to the final shape, it is good practice to leave some stock for finish-grinding, as in the semi-sintered state, sharp cutting edges are somewhat difficult to attain, and in certain types of tips a slight warping may occur.

Final Sintering or Hardening Process

The final sintering or hardening process causes the binder to cement the carbide particles together firmly into a hardened homogeneous solid. In most of the sintering operations, the binder, or at least a portion of it, actually becomes liquid. In this operation, a shrinkage of approximately 15 per cent occurs on all linear dimensions. This final operation is quite important, as warping, blistering, decarburization, etc., can occur if the conditions are not ideal.

The temperature range at which the final sintering occurs varies according to the size and the nature of the material being treated. Usually, the range is from 1350 to 1550 degrees C. All furnace operations required in the production of cemented carbides are carried out in a non-oxidizing atmosphere of pure hydrogen. The hydrogen is produced in the company's own plant, and the standard of quality is maintained at a very high degree. A record system is used which enables a check to be made of every operation even to the very source of

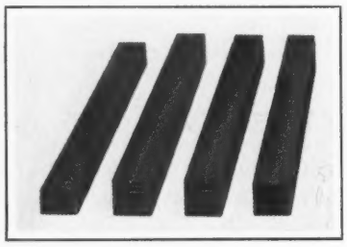
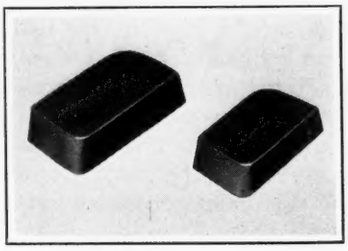


Fig. 3. (Left) Formed Carboloy Blanks or Ingots after They have been Subjected to the Semi-sintering Process. Fig. 4. (Right) A Carboloy Tip Cut to Shape from Blank Material such as Shown in Fig. 3, and the Same Tip after Sintering



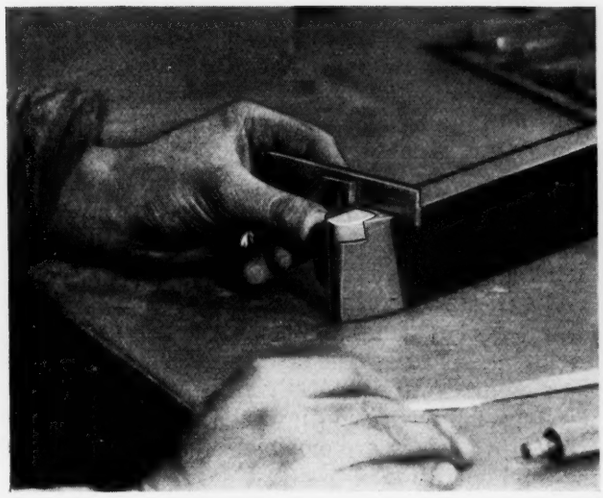


Fig. 5. The Hardened Carboloy Tip is Carefully Fitted in the Recess of the Shank, Special Care Being Taken to Provide a Full Bearing on the Bottom of the Recess, Thus Obtaining Maximum Support

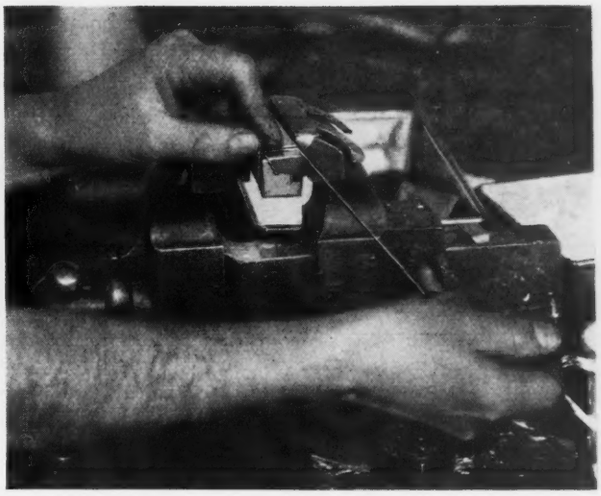


Fig. 6. Thin Sheets of Copper are Fitted around the Carboloy Tips in the Recess of the Shank, and the Parts are Wrapped with Iron Wire to Hold Them Securely in Place while Brazing

the raw materials. A sample of each lot of Carboloy metal produced is also kept on file to facilitate duplication or comparison.

Making the Shanks for Carboloy Tools

Many of the Carboloy tools now in use are quite complicated and present numerous difficult fabricating problems. In general, however, they comprise tools having a steel shank and a Carboloy tip or tips made in a variety of shapes. The prime requisite of the steel used for the shanks is that it be one to which Carboloy can be successfully brazed. This is determined by brazing a piece of Carboloy to the steel, then pushing it off under hydraulic pressure, and calculating, in pounds per square inch, the load necessary to push the tip off.

A steel having the proper brazing qualities is also investigated for other physical properties, such as freedom from cracking or warping during the brazing operation. The hardness and toughness are also considered. A large number and variety of steels were tested in selecting the tool steel now used. There are a number of steels that can be used more or less successfully, depending on the particular nature of the application.

All angles, forms, etc., required in the steel shanks are produced during the milling operation and before the Carboloy tip is applied. The type of tool and the tolerances specified determine what stock allowance shall be made to take care of warping, etc., and also for the finish-grinding. It is the usual practice to allow a very limited amount of stock on the shank for grinding.

The recess for the Carboloy tip is milled flat, and great care is taken to prevent any semblance of humps, etc. The recesses are sometimes made to suit the tips after the tips have been hardened, in order to eliminate excessive grinding of the Carboloy; ordinarily, however, the fitting is done after milling the recesses. After the recesses have been milled, the shanks are thoroughly washed in carbon tetrachloride to remove oil, grease, etc.

Preparing and Attaching Tip to Shank

Upon being removed from the sintering furnace, the tip is ground on all faces that will come in contact with the steel shank, great care being taken to see that the tip is properly fitted to the recess, and it is then washed in carbon tetrachloride. After fitting the tip to the shank and washing both pieces thoroughly in carbon tetrachloride, a piece of very thin sheet copper is fitted to the bottom of the recess. Another piece of this copper is then fitted around the side and back of the recess.

The tip is now tied down to the shank by wrapping a few strands of soft iron wire around the two parts. Next, a piece of copper is placed on top of the tip to serve as a temperature indi-

Fig. 7. The Carboloy Tips are Brazed to the Shanks in a Brazing Furnace having a Non-oxidizing Atmosphere

cator and to fill any crevices that may be present when it melts and flows. The shank with the tip attached is then dipped once more in carbon tetrachloride, after which it is covered with a suitable flux for the brazing operation.

Performing the Brazing Operation

A number of methods are used for brazing cemented tungsten-carbide tips to their shanks. One is to use an electric furnace with a hydrogen or non-oxidizing atmosphere. This is the method used by the Carboloy Co. Another method is to use a gas furnace with a non-oxidizing atmosphere. An oxy-acetylene torch may also be used for the brazing operation if care is taken to keep oxidation at a minimum.

The method used in the production of standard Carboloy tools is to take the shank, to which the brazing medium and the Carboloy tip have been attached, and introduce it into the furnace. The temperature is allowed to rise until the melting point of the brazing medium is reached. After the tool has been held for a minute or two at this temperature, it is pushed into the cooling chamber. Upon being removed from the cooling chamber, the tool is ready for grinding.

The procedure in preparing the tip and shank for the braze and the actual brazing process have been developed to the extent that tool failure, because of an imperfect braze, is a rare occurrence.

Heat-Treating and Grinding the Shanks

It has been found feasible to heat-treat the shanks after the Carboloy has been attached. This is done in the case of special applications, such as drills, reamers, etc. A Rockwell hardness of 60 C. can be attained, at the same time retaining all other physical properties in the steel shank and in the Carboloy.

Grinding is, perhaps, the most important factor in the manufacture of Carboloy tools. The most careful workmanship and technique employed prior to this stage are of no avail if correct grinding methods are not used. Only skilled men who have been specially trained in the correct method of grinding Carboloy are employed for this important and final operation.

[An article on the proper method of grinding Carboloy tools appeared in May MACHINERY on page 679.]

In general, it is the practice to do as much grinding free-hand as possible, and to do the finishing on surface grinding machines in the case of flat work, and on circular grinding machines in the case of circular work, with perhaps some lapping or honing, depending on the tool. Every Carboloy tool is finally subjected to a careful inspection for tolerance, hardness, and other characteristics before leaving the plant. A tool is shown being inspected in the heading illustration.

Inspection Control to Insure Accuracy

It is interesting to note the advances that have been made in inspection methods during recent years in most progressive plants, particularly in the automotive field. Here "operation inspection" is the rule rather than the exception, so that if an error is made, the part stops at that particular operation and does not proceed to the final operation, then to be cast into the scrap heap. The manufacture of transmission gears will serve to illustrate how the various operations are conducted.

First, the forged blanks are carefully inspected to see that they will "clean up." They are then bored, faced, and turned, and inspected again before broaching or rough-cutting the teeth.

Finish-cutting follows. Experience has proved that a finishing cutter will cut only a certain number of gears before its keen cutting edge is sufficiently affected to produce a rough surface on the teeth. No attempt is made to cut more than the specified number of gears—the cutter is then removed and replaced by a sharp one.

As a further check on accuracy, particularly as it is conducive to quiet operation, every thirtieth gear, as it comes from the finish gear-cutters, is tested by coating the tooth surfaces with red lead and placing it in contact with a master gear of known accuracy on a "speeder." Here it is tested for accuracy of tooth profile and noise. This test is made on gears taken from every machine in the line, the gears being marked so that the machine at fault can be immediately located and the trouble rectified.

Following finish-cutting, the teeth are burnished and the gears are then transferred to the hardening department. After hardening, they are again burnished, using worn-out burnishing gears to remove the fine scale resulting from heat-treatment. The final operation on the teeth is lapping, after which the gears are again tested for tooth bearing and noise on speeders.

So complete is the inspection control over all operations that the "tear downs" after assembly, because of unsatisfactory operation, have been reduced to less than 5 per cent of what they formerly were. In ninety-nine out of one hundred cases, the rejected gear assemblies can be salvaged, thus reducing scrap to the minimum.

* * *

In an address before the Milwaukee Section of the Society of Automotive Engineers, L. J. Kanitz, general sales manager of the Continental Motors Corporation, described his recent trip to Russia. He said that the five-year plan continues to be Russia's inspiration, but he did not think that it could be accomplished within the time limits set.

New Helical Spring Formulas and Tables

By A. M. WAHL
Westinghouse Electric & Mfg. Co.

[For some time, engineers have noticed that heavy, closely coiled, helical springs, such as are used on railway trucks, frequently broke under loads that the universally accepted formulas indicated were within their strength. Generally, the blame was laid to careless heat-treatment. The author of this article, however, became suspicious of the accepted formulas. Working from the ground up, he made a mathematical analysis of stress distribution in large helical springs, and found the actual shearing stress to be 40 to 60 per cent greater than was given by the accepted formulas, and that, in certain practical cases, the stress piled up on the inside surface of the spring to 240 per cent of that on the outside.

New formulas, devised on the results of this anal-

Table 1. Maximum Loads, in Pounds, and Deflections per Coil, in Inches, for Helical Springs from 1/8 to 7/8 Inch Outside Diameter

Diameter of Wire, Inch		Outside Diameter of Spring, Inch										
		1/8	5/32	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8
0.014	P	0.817	0.660	0.552	0.410	0.324						
	F	0.0195	0.0337	0.0508	0.0950	0.1534						
0.020	P	2.305	1.890	1.595	1.207	0.9665	0.7965	0.6775	0.592			
	F	0.0117	0.0208	0.0333	0.0646	0.1077	0.1574	0.2194	0.2887			
0.022	P	3.030	2.499	2.116	1.609	1.294	1.068	0.908	0.8065			
	F	0.0100	0.0180	0.0280	0.0572	0.0955	0.1409	0.1964	0.2593			
0.026	P	4.868	4.05	3.433	2.633	2.134	1.784	1.511	1.315	1.040		
	F	0.0073	0.0137	0.0225	0.0457	0.0773	0.1167	0.1625	0.215	0.345		
0.0286	P	6.35	5.31	4.532	3.416	2.822	2.360	2.025	1.758	1.390		
	F	0.0059	0.0116	0.0190	0.0394	0.0675	0.1024	0.1447	0.1922	0.3074		
0.0348	P	10.71	9.22	8.04	6.19	5.05	4.24	3.567	3.20	2.535	2.10	1.783
	F	0.0037	0.0080	0.0137	0.0297	0.0515	0.0799	0.1198	0.1541	0.2482	0.365	0.505
0.0410	P		14.47	12.62	9.88	8.13	6.87	5.92	5.22	4.19	3.45	2.935
	F		0.0055	0.0098	0.0225	0.0405	0.0638	0.0920	0.1252	0.2066	0.303	0.423
0.0475	P			19.00	15.15	12.47	10.62	9.13	8.10	6.50	5.40	4.60
	F			0.0072	0.0172	0.0320	0.0514	0.0750	0.1029	0.1716	0.258	0.360
0.0540	P			26.65	21.83	18.00	15.41	13.38	11.79	9.55	8.01	6.82
	F			0.0052	0.0135	0.0256	0.0419	0.0622	0.0863	0.1453	0.2215	0.310
0.0625	P				32.35	27.35	23.5	20.5	18.18	14.80	12.35	10.61
	F				0.0098	0.0197	0.0328	0.0495	0.0699	0.1203	0.1832	0.2615
0.0720	P				47.0	40.5	35.0	30.8	27.35	22.35	18.83	16.20
	F				0.0070	0.0148	0.0255	0.0392	0.0567	0.0983	0.1533	0.218
0.0800	P					54.0	47.0	41.5	37.0	30.35	25.5	22.15
	F					0.0115	0.0207	0.0325	0.0470	0.0841	0.1313	0.190
0.0915	P					76.7	68.4	60.7	54.4	44.9	38.0	32.9
	F					0.0084	0.0155	0.0251	0.0371	0.0682	0.1086	0.1586
0.106	P						101.2	91.3	82.2	68.4	58.2	50.55
	F						0.0109	0.0185	0.0280	0.0531	0.0865	0.1282
0.121	P						140.0	129.6	118.7	99.5	85.1	74.2
	F						0.0074	0.0134	0.0211	0.0418	0.0694	0.1043
0.135	P								159.4	136.0	117.2	102.0
	F								0.0162	0.0336	0.0573	0.0874
0.148	P								203.7	175.0	151.2	133.1
	F								0.0129	0.0278	0.0484	0.0747
0.162	P									223.5	194.5	172.7
	F									0.0225	0.0404	0.0636
0.177	P									281.8	249	220
	F									0.0182	0.0334	0.0540
0.207	P										379	342
	F										0.0231	0.0389
0.225	P										473	427
	F										0.0187	0.0323

Note: P = Load at maximum stress of 100,000 pounds per square inch.

F = Deflection per turn of spring at maximum stress of 100,000 pounds per square inch, or at load P.

To find load or deflection at permissible working stress, multiply the table values by the ratio $\frac{\text{working stress}}{100{,}000}$.

ysis, were checked by testing helical springs under actual load conditions. The measurements were taken by means of extensometers, and the visual proof supported the theoretical results in every detail.—EDITOR]

Recent research on the question of stress in hel-

Table 2. Maximum Loads, in Pounds, and Deflections per Coil, in Inches, for Helical Springs from 1 to 2 1/2 Inches Outside Diameter

Diameter of Wire, Inch		Outside Diameter of Spring, Inches										
		1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/4	2 1/2
0.0410	P	2.55										
	F	0.557										
0.0475	P	4.01	3.53									
	F	0.475	0.610									
0.0540	P	5.93	5.24	4.69								
	F	0.412	0.529	0.660								
0.0625	P	9.25	8.15	7.30	6.61	6.01						
	F	0.350	0.450	0.562	0.686	0.825						
0.0720	P	14.19	12.5	11.25	10.2	9.26						
	F	0.295	0.382	0.4785	0.586	0.705						
0.0800	P	19.32	17.32	15.5	13.97	12.83	11.77					
	F	0.258	0.338	0.425	0.5385	0.6285	0.744					
0.0915	P	28.9	25.8	23.25	21.1	19.27	17.73					
	F	0.2164	0.2855	0.360	0.4475	0.540	0.6385					
0.106	P	44.53	40.7	36.0	32.9	30.0	27.8	25.8				
	F	0.1769	0.2362	0.300	0.3725	0.4545	0.540	0.633				
0.121	P	66.0	58.9	53.3	48.55	44.55	41.3	38.35	35.8			
	F	0.1465	0.1962	0.251	0.3145	0.3856	0.460	0.544	0.633			
0.135	P	91.1	81.4	73.8	67.3	61.85	57.3	53.3	49.6	46.7	41.1	
	F	0.1241	0.1669	0.2163	0.2708	0.3327	0.402	0.474	0.554	0.638	0.822	
0.148	P	118.1	106.8	96.8	88.5	81.1	75.3	70.0	65.6	61.45	55.1	
	F	0.1068	0.1454	0.1909	0.2381	0.2944	0.3545	0.420	0.494	0.569	0.749	
0.162	P	152.2	137.7	125.2	115.0	106.0	98.3	91.45	85.8	80.5	71.8	64.4
	F	0.0914	0.1262	0.1654	0.211	0.258	0.3145	0.3727	0.440	0.506	0.6655	0.840
0.177	P	198.2	178.2	162.8	149.4	137.8	127.7	119.5	111.3	105	93.2	84.0
	F	0.0791	0.1082	0.1429	0.1836	0.2273	0.2781	0.3308	0.3908	0.4544	0.5945	0.7525
0.207	P	308	279	256	235.5	216.5	202.5	188	176.5	166.7	149	133.9
	F	0.0588	0.0827	0.1114	0.1432	0.1797	0.2208	0.2645	0.3145	0.3667	0.4835	0.619
0.225	P	387.5	354	323	295.5	275	258.5	241.5	225	212.5	190.1	171.2
	F	0.0496	0.0706	0.0954	0.1244	0.1568	0.1932	0.2355	0.2772	0.325	0.434	0.556
0.263	P	594	544	500	464.5	431	402	377	354	333	300	273
	F	0.035	0.0511	0.0709	0.0942	0.1191	0.1492	0.1819	0.2187	0.2562	0.3458	0.448
0.283	P		669	619	571	533.5	498	466	439.5	414	373	339.6
	F		0.0435	0.0611	0.0814	0.1052	0.1320	0.1603	0.1933	0.229	0.3125	0.404
0.307	P		829	773	719	671	629	590	556	525	473	433.5
	F		0.0358	0.0511	0.0691	0.090	0.1138	0.1402	0.1693	0.2004	0.275	0.3605
0.331	P		1007	945	883	829	778.5	733	693	652	588.5	536
	F		0.0295	0.0428	0.0586	0.0774	0.0986	0.1219	0.1481	0.1767	0.243	0.3165
0.363	P			1223	1152	1088	1019	970	914	864.5	781	712
	F			0.0340	0.0476	0.0638	0.0814	0.1027	0.1255	0.1512	0.2088	0.276
0.394	P					1324	1262	1192	1127	1072	970	883.5
	F					0.0524	0.0688	0.0864	0.1062	0.1291	0.1803	0.2403
0.430	P						1596	1515	1452	1363	1248	1138
	F						0.0559	0.0717	0.0903	0.1090	0.1548	0.2085
0.460	P							1827	1722	1646	1505	1388
	F							0.0609	0.0769	0.0943	0.1352	0.1857
1/2	P									2064	1902	1745
	F									0.0786	0.1148	0.1571
9/16	P									2805	2620	2430
	F									0.0586	0.0884	0.1237
5/8	P										3470	3220
	F										0.0686	0.0981

Note: P = Load at maximum stress of 100,000 pounds per square inch.

F = Deflection per turn of spring at maximum stress of 100,000 pounds per square inch, or at load P.

To find load or deflection at permissible working stress, multiply the table values by the ratio $\frac{\text{working stress}}{100{,}000}$.

ical springs axially loaded has shown conclusively that the ordinary helical spring formulas may give results greatly in error. This is particularly true for springs of small index, that is, for those having a small ratio between the coil diameter and the wire diameter. The error may amount to as much as 60 per cent.

Since ordinary spring tables are based on the accepted formulas, it follows that the tables are also in error. For this reason, new tables have been prepared, as presented here, based on more accurate formulas, which have been checked up by the research. The new formulas are given in the following:

Table 3. Maximum Loads, in Pounds, and Deflections per Coil, in Inches, for Helical Springs from 2 3/4 to 7 1/2 Inches Outside Diameter

Diameter of Wire, Inches		Outside Diameter of Spring, Inches										
		2 3/4	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2
0.177	P	76.0										
	F	0.929										
0.207	P	122.4	112	95.5								
	F	0.766	0.930	1.298								
0.225	P	156.8	144	123.5								
	F	0.690	0.844	1.181								
0.263	P	250	229.3	197.3	171.9							
	F	0.5625	0.687	0.981	1.317							
0.283	P	308.2	285.5	245.6	214.5							
	F	0.5085	0.625	0.891	1.209							
0.307	P	393.5	360.3	312.5	275	243.5						
	F	0.454	0.5585	0.802	1.089	1.415						
0.331	P	491	452	390.5	342.8	304.5						
	F	0.4045	0.502	0.755	0.993	1.298						
0.363	P	655	604.5	524	459	409						
	F	0.3545	0.441	0.6405	0.879	1.150						
0.394	P	812	752	652	576	514	464					
	F	0.309	0.388	0.569	0.7855	1.032	1.322					
0.430	P	1048	970	844	743	664.5	602.5					
	F	0.2666	0.338	0.500	0.695	0.9215	1.177					
0.460	P	1269	1179	1026	907	805	734	671				
	F	0.2403	0.3022	0.452	0.631	0.834	1.077	1.342				
1/2	P	1613	1500	1308	1160	1041	941	857	788			
	F	0.208	0.262	0.3955	0.560	0.748	0.962	1.205	1.471			
9/16	P	2250	2095	1836	1632	1472	1328	1214	1118	1033		
	F	0.1644	0.2135	0.325	0.464	0.628	0.814	1.025	1.258	1.518		
5/8	P	3000	2805	2490	2202	1993	1811	1659	1521	1417		
	F	0.1340	0.1736	0.2736	0.3915	0.536	0.700	0.8835	1.088	1.320		
11/16	P	3916	3722	3253	2915	2635	2398	2188	2020	1875		
	F	0.1081	0.1441	0.2273	0.3305	0.456	0.600	0.767	0.950	1.157		
3/4	P		4660	4140	3750	3390	3054	2836	2618	2424	2258	
	F		0.1174	0.1910	0.2832	0.3945	0.519	0.672	0.836	1.026	1.222	
13/16	P			5190	4660	4250	3860	3557	3275	3055	2832	
	F			0.162	0.2435	0.3415	0.458	0.589	0.736	0.909	1.098	
7/8	P			6330	5720	5240	4810	4420	4085	3805	3525	
	F			0.1368	0.2098	0.300	0.403	0.522	0.658	0.808	0.972	
15/16	P				6945	6360	5840	5360	4970	4640	4335	
	F				0.1811	0.262	0.3555	0.464	0.586	0.725	0.878	
1	P				8280	7590	7000	6460	6000	5590	5215	
	F				0.1567	0.229	0.3125	0.4125	0.525	0.650	0.794	
1 1/8	P					10470	9710	9000	8410	7810	7340	
	F					0.1762	0.246	0.3310	0.425	0.531	0.650	
1 1/4	P						12930	12090	11280	10560	9940	9380
	F						0.1961	0.2672	0.3467	0.441	0.544	0.660
1 3/8	P							15650	14610	13810	13030	12280
	F							0.2156	0.2843	0.3623	0.453	0.556
1 1/2	P								18670	17570	16630	15700
	F								0.2353	0.302	0.3845	0.4685

Note: P = Load at maximum stress of 100,000 pounds per square inch.

F = Deflection per turn of spring at maximum stress of 100,000 pounds per square inch, or at load P.

To find load or deflection at permissible working stress, multiply the table values by the ratio $\frac{\text{working stress}}{100{,}000}$.

$$S = K\frac{16Pr}{\pi d^3}$$

$$K = \frac{4c-1}{4c-4} + \frac{0.615}{c}$$

$$F = \frac{64Pr^3}{d^4G}$$

in which

S = maximum shearing stress in spring;
P = load on spring corresponding to stress S;
r = mean radius of coil;
d = diameter of wire;

$c = \frac{2r}{d}$ = the ratio $\frac{\text{mean coil diameter}}{\text{wire diameter}}$;

G = modulus of rigidity of the material, or modulus of elasticity in shear; and
F = deflection per turn at load P.

In these tables, the modulus of rigidity G was taken as 11,500,000 pounds per square inch.

These formulas are the same as those ordinarily used for computing spring tables, except that the stress formula is multiplied by a factor K greater than unity, this factor being dependent on the ratio of the mean coil diameter to the wire diameter.

The tables give the load and deflection on springs of different sizes at a maximum stress of 100,000 pounds per square inch. To find the load or deflection at any other working stress, the values given by the tables should be multiplied by the ratio $\frac{\text{working stress}}{100{,}000}$. The tables give the wire sizes used by the company with which the writer is associated. It should be noted that the stress of 100,000 pounds per square inch, on which these tables are based, is *not* the recommended working stress, but is used merely for convenience.

The matter of choosing the working stress for various applications of helical springs is very involved and cannot be treated here in detail. The proper working stress depends on such factors as the kind of material, number of repetitions of stress, seriousness of failure, range of stress, possibility of corrosion, heat-treatment, etc. Also, in many cases, the possibility of vibration or surging of the springs must be considered.

The object of publishing these tables is to give designers a convenient and accurate means of determining maximum stress in helical springs without the necessity of laborious computation.

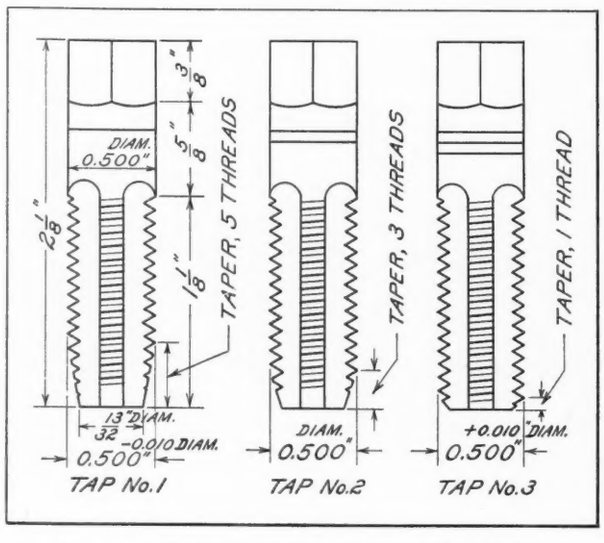
Design of Taps for Tapping Blind Holes

By RUDOLF MAIER

The accompanying illustration shows a set of three taps especially designed for tapping blind holes. These taps differ in several essential points from standard designs: First, the lengths of both the shank and the threaded part are made shorter than usual; second, the shank diameter is made to the full size of the threaded part; third, the square for the wrench, being made the right proportion for the full-diameter shank, is larger than it would be on ordinary taps of this size; fourth, the chamfers or the tapers at the ends of the threads are so proportioned as to assure an equal distribution of the tapping work between the different taps in the set.

By designing taps for tapping blind holes in this way, the strength of the tap is greatly increased, breakage of taps is eliminated to a large extent, and a full perfect thread practically to the bottom of the hole is insured. If taps of this type were adopted as standard for tapping blind holes, they could be manufactured in quantity. They would cost less rather than more, as compared with standard taps —first, because the threaded part is much shorter; second, because the shank need not be turned down; and third, because the taps as a whole are shorter and hence require less material.

The writer believes that by proper advertising the manufacturers of taps could easily develop a large market for short, sturdy taps specially designed for tapping blind holes. Under those circumstances, there is no reason why they should not be carried as a "standard" product and sold at a "standard" price. Once introduced, there would be a steady market for them.



Design of Taps Intended for Tapping Blind Holes

New Developments in Hard Carbide Materials

A Brief Review of Some of the Recent Discoveries that Have Made it Possible to Use the New Carbide Tools for Machining Steel

By GREGORY J. COMSTOCK, Director of Research
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A NEW series of hard cemented-carbide materials has recently been made available for commercial application. Possibly the most notable characteristic of these new materials, and certainly the one upon which interest is at present being centered, is their ability to machine steel more satisfactorily than the first sintered materials which were produced. Their advent has another significance, however, in that they demonstrate that the sintering art or metallurgy by which the original materials of this kind were produced has been developed to a degree that will permit the production of new materials to meet definite problems of application, like the cutting of steel. This should be encouraging both to those who are profitably applying these new cutting materials to their manufacturing operations at present and to those whose specific problems are yet to be solved.

The theory upon which these new steel cutting cemented carbides are constructed is interesting, and may be briefly and non-technically described.

Why the Early Cemented Carbides Were Not Successful in Machining Steel

The original cemented tungsten-carbide products consisted of extremely small particles of an unusually hard abrasive (tungsten carbide), set in a metallic matrix or cement consisting of an alloy of tungsten, carbon, and cobalt. Almost at once it was recognized that the toughness of these products could be increased or decreased at will by regulating the amount of the metallic cement used in binding the abrasive particles. Altering the quantity of binder was attended by other characteristic changes, and cemented-carbide products of greater or less resistance to abrasion, and varying in their ultimate hardness, were produced by this means. Until the advent of the new steel-cutting carbide materials all the various commercial grades of cemented tungsten carbide were either produced by such quantity variations of the binder constituent or by the regulation of the size of the abrasive particles.

Although cemented tungsten carbide was generally admitted to be superior to any previous material developed for cutting metals at high speed, it was found that when it was applied to machining steel, a chip cavity or crater was developed directly behind the cutting edge of the tool. This crater was usually sufficiently deep to shorten materially the cutting life of the tool tipped with the cemented tungsten-carbide product, requiring grinding at frequent intervals, with the consequent removal of considerable quantities of the hard alloy tip.

Investigation indicated quite positively that the formation of such chip cavities was traceable to the seizing of the chip, which was produced in the machining operation, to the cemented-carbide material. The relatively high heat conductivity of cemented tungsten carbide was responsible for a heat transference from the chip to the carbide tip of the cutting tool, causing it to become excessively hot and to further promote this seizing action.

Still further experiment brought out the fact that the substitution of finely divided tantalum-carbide particles for finely divided tungsten-carbide particles and cementing them with a tantalum-carbon-tungsten-cobalt alloy, which was developed during the sintering operation, produced a material that would cut steel without developing the objectionable crater behind the cutting edge of the tool, previously referred to.

At first it was believed that the problem of developing satisfactory steel cutting materials had been solved. A relatively simple experiment, however, indicated that the tantalum-carbide particles lacked the strength of the tungsten-carbide grains which had previously been used and that cemented tantalum carbide was disappointingly lacking in strength. In other words, the two materials that had been produced up to this point might be compared to two brick walls, one of which was constructed of strong vitrified brick (tungsten car-

bide), cemented in place with a satisfactory cement or plaster, and the other of weak easily crushed bricks (tantalum carbide), cemented with a stronger bonding medium.

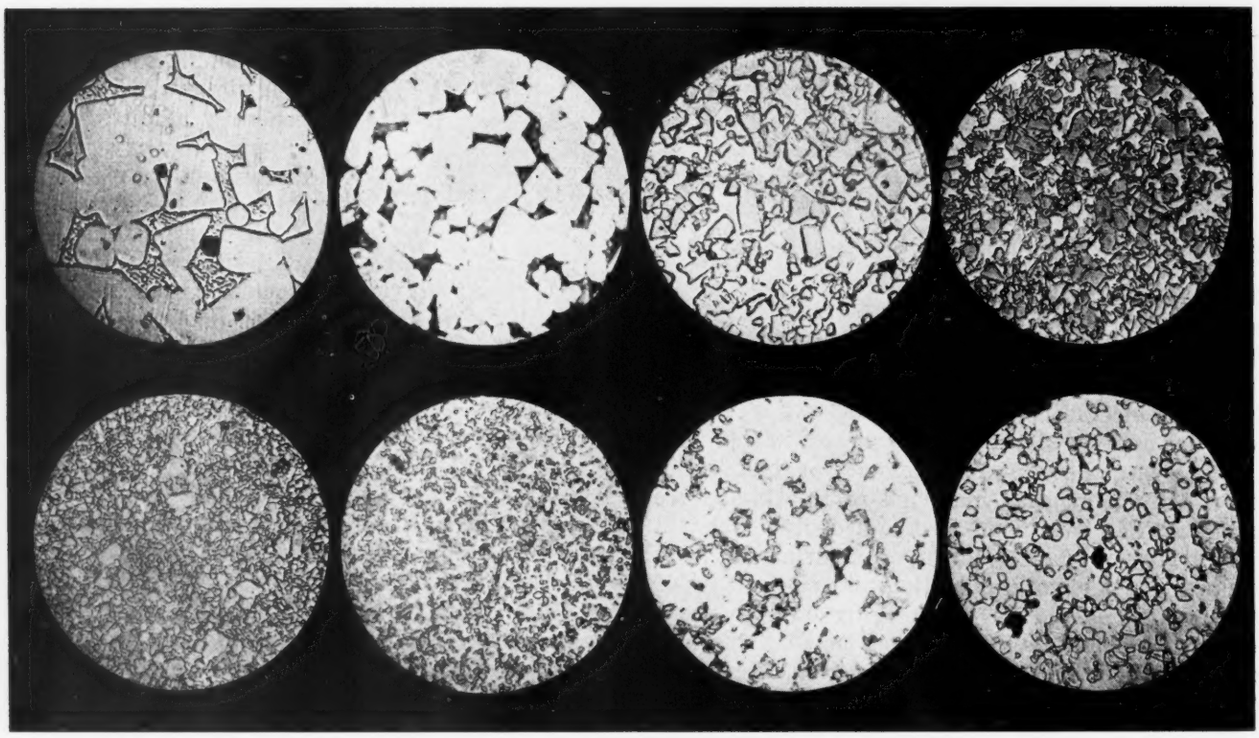
The Next Discovery Indicated the Value of Tantalum in the Binder

An intensive study of these two cemented carbides indicated that at least some of the steel-cutting properties of the cemented tantalum-carbide material were attributable to the particular physical properties of the alloy cement that bound the small particles of tantalum carbide in place. It was felt that were it possible to bind the stronger tungsten-carbide grains in a metal matrix of a similar composition to that developed during the cementation of tantalum carbide, a product might be secured that would display a strength equal or superior to the cemented tungsten-carbide materials that had previously been produced, and in addition would possess the steel-cutting capacity of cemented tantalum carbide.

Fortunately the rather complicated technique of manufacturing these sintered materials had been developed sufficiently to permit this to be accomplished; the anticipated results followed, and hard cemented materials entered into the second and possibly more important phase of their development thus far. The possibility of developing alloy bonding materials possessing predetermined characteristics will undoubtedly exert a profound effect on the hard carbide materials of the future.

The Latest Carbide Tools Cut Steel Successfully

The steel-cutting materials that have been made according to this development consist, therefore, of cemented tungsten carbide. The tungsten-carbide particles are bonded in a metal matrix consisting of an alloy of the elements tantalum, tungsten, carbon, and cobalt. The introduction of tantalum as a binder additive has so changed the character of the bonding cement that the undesirable chip cavity is no longer produced when tips of tungsten carbide bound in this way are applied to the machining of steel and other ferrous alloys developing excessive heat and pressure during the machining operation.



Heavy Carbides Cemented with Alloys of Different Compositions, Illustrating the Structural Variations Produced

As might be expected, the development of an alloy bonding medium that successfully overcame what was at first feared to be an inherent weakness of hard sintered products has been extremely encouraging to those who are engaged in the development of these materials. Further experiment has given positive indications of the possibility of developing by the same means other special physical characteristics that are particularly suitable for specific applications of hard carbide materials.

Recent Experiments Point to Still Further Developments

The development of unusual strength, as evidenced by resistance to transverse rupture, without too great a sacrifice of ultimate hardness and resistance to abrasion is one of the problems now engag-

ing the attention of those working on these materials. The results of this particular development, thus far, may be said to have exceeded all expectations, and materials are now becoming available for use that, in addition to possessing carbide cutting efficiency, compare favorably in strength with any of the known "super cutting" alloys.

Hard cemented-carbide materials are novel in their conception and are made by what until recently was a practically unknown metallurgy. Their physical properties, even in their preliminary or introductory form, were such that when they were applied to cutting and drawing tools, they created more possibilities for economic changes in manufacturing procedure than any other tool materials which have previously been developed.

Cemented tungsten carbide, as the first product of a new metallurgy, was not preceded by materials representing easy transition stages of increasing efficiency from the cutting alloys that had been developed through the ages by the old metallurgy of melted alloys. It suddenly appeared out of the blue, with properties of hardness and resistance to abrasion that were many times greater than those that had previously been regarded possible in any commercial material. However startling the character of this material appeared and no matter what innovations in manufacturing operations its application afforded, the question as to whether it was the first of a series of increasingly valuable materials or one product of a process of metallurgy that was capable of little manipulation or improvement remained to be answered.

Fortunately it possessed one decisively characteristic fault—its inability to machine steel economically. The incentive was therefore immediately afforded to answer the question as to whether or not hard cemented-carbide products were made by a process that was capable of development. It is becoming increasingly evident, even to the most skeptical, that the new tantalum-bearing cemented tungsten-carbide materials are performing as satisfactorily, and with no less startling efficiency when machining steel, as did the first cemented materials in machining cast iron and non-ferrous alloys.

In view of these facts, it seems reasonable to expect many further improvements in hard cemented-carbide materials. The advent of the new steel-cutting carbides should indicate that these developments will not be limited by the process by which they are produced, but only by the skill, energy, and ingenuity of those engaged in their production.

Is the Man Who Makes the Finest Drawings the Best Designer?

The maker of the finest drawings is no more likely to be the best designer than a fine penman is certain to be the best author or the neatest score writer the best composer of grand opera. The writer is a firm believer in good clear drawings, but the recollection of many good designs that were poorly drawn, and many poor designs that were excellently drawn, creates the conviction that there is no direct relation between a man's ability as a draftsman and his ability as a designer.

ARTHUR W. SUITER

What is a machine designer? The best description that I know was that given on the editorial page of June, 1922, MACHINERY: "The successful machine designer must not only know how to design a machine or apparatus that will function according to mechanical laws, but he must also understand how the machine is to be built and how the parts are to be machined and assembled, so that every part incorporated in the machine will be so designed and arranged that it can be produced at the minimum cost."

It would take too much space to tell how one may become a good machine designer, but if the younger men will start out to complete each task in the (1) best, (2) easiest, and (3) quickest way, in the order given, they will be on the right track.

To have the ability to make "nice" drawings is a great asset to any draftsman, designer, or engineer. I cannot agree with the statement that "men who make 'nice' drawings are, as a rule, mechanically inefficient and mentally slow."

Any young man who is ambitious to become a draftsman or designer should note the statements made under the heading "Is the Man Who Makes the Finest Drawings the Best Designer?" on page 617 of April MACHINERY. CHARLES L. GROVER

In my opinion the essential qualifications of a designer are as follows: He must be capable of originating new ideas for better tools and machines and of developing these ideas so that they are practical, simple, and easily manufactured. He also must be able to present the idea in a clear and accurate manner on a drawing, with the fewest lines possible.

When a man has the ability to develop valuable ideas, why should he spend hours of his time in making drawings with fancy shading and fine lettering? The most practical designer known to the writer usually makes free-hand sketches, which are remarkably clear and easily understood by the shop men. What he draws out completely on the board, he shows clearly with fewer lines and views than anyone else that the writer knows of. These drawings are made to scale, but never shaded, nor is fancy lettering employed. Notes and information are written in clearly. Some of the most worthless ideas that the writer has ever seen were masterpieces of mechanical drawing. D. A. SHAW

. . . but most of it never happened

"I have seen lots of trouble in my day," said an old Gloucester skipper, "but most of it never happened."

Recently we came across a quotation from the New York Tribune of July 11, 1887, headed "The Exhaustion of Petroleum—from Knowledge." The author, basing his observations upon the statements of the most respected authorities on geology and oil production at the time, said that the supply of both oil and gas "has now been so largely drawn upon that within less than a score of years scarcely any will be left which can be brought at reasonable cost into the market.

"The boundaries and extent of the oil regions have been determined. All the sands in which oil will ever be found in such quantities as to be worth working are known and have been drilled through in various places. It is scarcely possible that any new fields will be discovered which will be comparable either in extent or productiveness with those now known."

The supply of oil today is so plentiful that the greatest problem of the oil industry is to dispose of the surplus output!

The quotation from the Tribune happens to apply to oil, but similar prophecies have been made many times with regard to almost every industry. During the depression in 1907, which, although of comparatively brief duration, was severe while it lasted, prominent men in the mechanical field predicted that there would be no recovery for years in the machinery industries, because all the plants to be equipped, already were equipped.

In 1911, we were told that the automobile plants were fully equipped and would offer no further outlet for machine shop equipment. Moreover, automobile production had reached the saturation point. The industry had become stabilized; everyone who could afford an automobile had already bought one.

In 1921, we learned that it was impossible to conceive of any new industries that would require equipment. The plants engaged in the shop equipment business could not expect any marked activity for a decade to come. Nevertheless, in a few years, the vastly expanded plants built during the war were running to capacity and quoting on machinery for delivery six, eight, and ten months ahead.

Well-known economists made predictions with equal assurance and with equal inaccuracy. On November 4, 1921, they told us: "The general prospect is for slow . . . business for ten years . . . It is a conservative estimate to say that ten years must elapse before we can see genuinely prosperous business in this country." There was nothing ahead for the world for years to come but limited production, unemployment, low wages, and general stagnation. Five years later this country entered upon the greatest business activity that it has ever known, an activity not equalled even during the busy war years.

We are now being told by men supposed to be authorities that we have entered upon an era of stagnation, or at best, a period of years of very slow recovery. Were it not for the fact that the authorities have been wrong so often in the past, we might believe them.

Fortunately, however, the industrial history of the past and the recorded errors of the prophets of calamity give ample reason for hoisting the flag of courage and confidence, no matter how pressing our troubles may be at the moment. These United States have acquired a habit of ignoring predictions and of overcoming difficulties by forging ahead to new successes.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Escapement Mechanism for Actuating a Slide in a Magazine Die

By EDWARD LAY

Several automatic magazine dies used in one plant for piercing and trimming operations on previously blanked parts are equipped with stop mechanisms like that shown in Fig. 1. During the upward stroke of the press ram, this mechanism serves to move the work locating stop *A* toward the right to permit the finished part to be ejected and a new blank to be put in place. Before the ram has reached the top of its stroke, the stop returns to its former position against the new blank. During the entire downward stroke of the ram, the stop is stationary.

As indicated in Fig. 2, stop *A* is riveted to the slide *B*, which is shown in Fig. 1 mounted in the die bolster. Cam-arm *C* is pivoted to the punch-holder and can be swung in the direction of the arrow. At the top of the stroke, the lower end of this arm assumes a position corresponding with the sectional area in Fig. 2, and is normally held there by the spring-actuated plunger *D*, Fig. 1.

As the press ram descends, the angular edge at the bottom of the projection *E* on the arm engages edge *F* on the slide, causing the arm to swing in the direction of the arrow. Upon the continued descent of the ram, the projection *E* passes the corner at *F*, allowing the arm to swing back to its normal position. During the entire downward stroke, slide *B* is held against the die by the spring-actuated plunger *G*, and therefore remains stationary.

As the ram begins to ascend, the angular edge at the top of projection *E* engages the under side of the corner at *F*, causing the slide to be moved

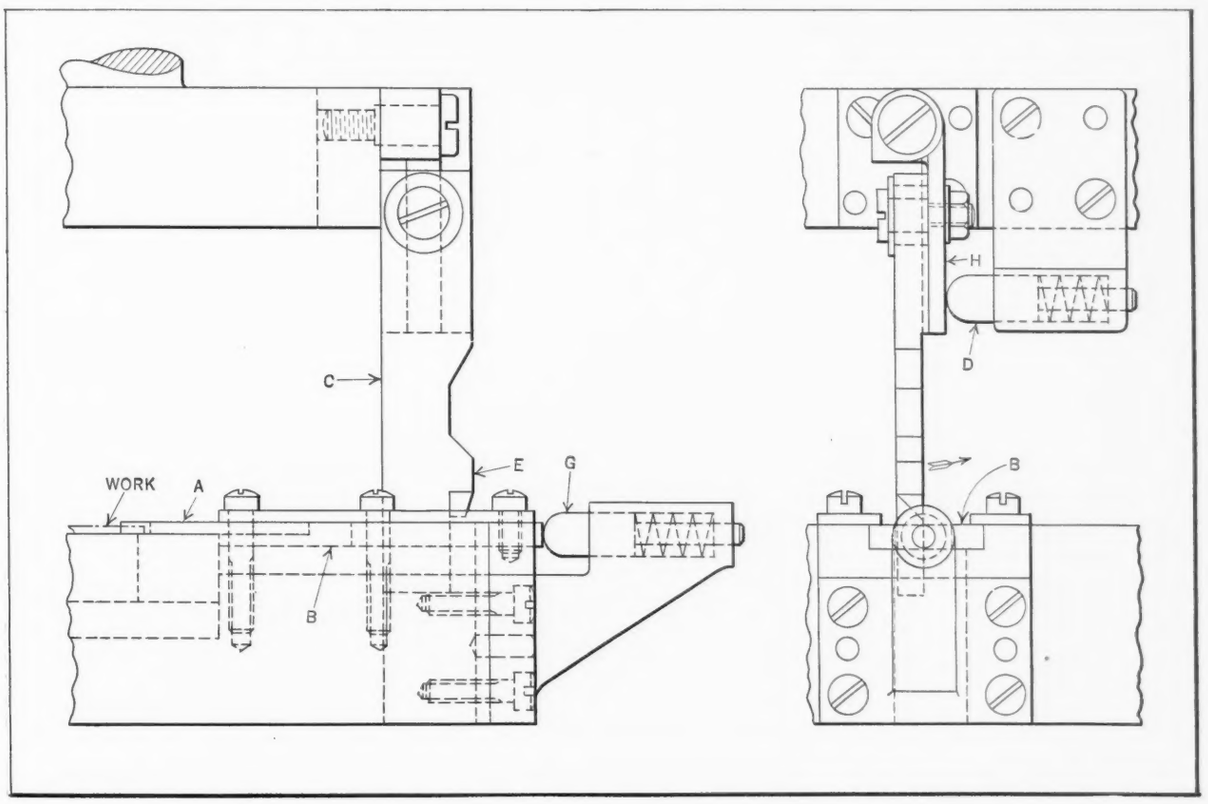


Fig. 1. Die Equipped with a Cam-arm that Imparts a Forward and Return Stroke to a Slide while the Ram Ascends. The Slide is Stationary while the Ram Descends

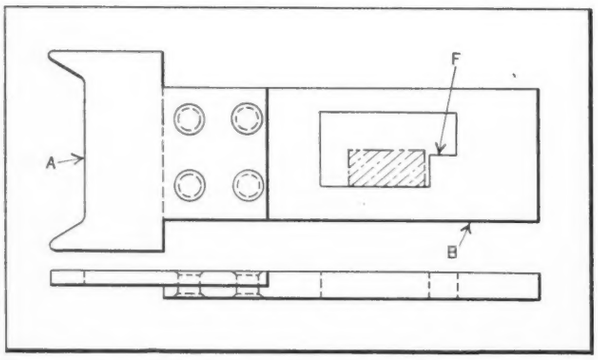


Fig. 2. Slide Actuated by the Mechanism Illustrated in Fig. 1

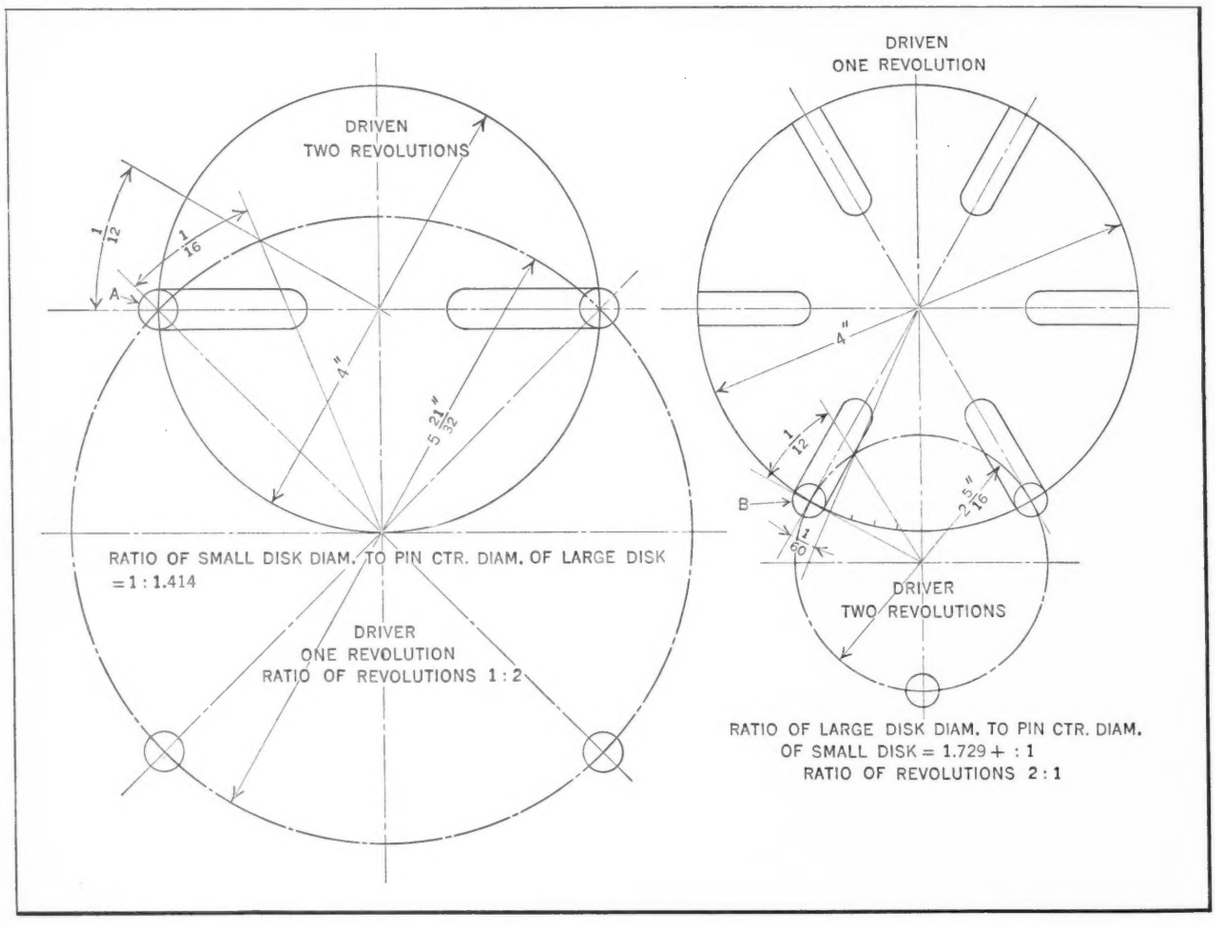
toward the right. At this point, the finished part is ejected from the die and a new blank is slid into place by means of the magazine feed slide (not shown). As the ram continues its upward movement, the projection *E* leaves the slide and the slide is returned by plunger *G* to a position against the new blank. The blank is thus located centrally over the die in readiness for the next downward stroke of the punch. The action of the stop slide can be timed accurately by adjusting the arm to its correct position along the hinge *H*.

Two Arrangements of a Pin and Slotted-Disk Driving Mechanism

By M. JACKER

Two driving mechanisms of the pin and slotted-disk type are shown diagrammatically in the accompanying illustration. The diagrams are practically self-explanatory, but attention might be directed to the varying speed ratios of the driven disks. Referring to the diagram at the left, let us assume that the driving movement is started by the pin at *A*. When the large disk or driver makes 1/16 revolution, the driven disk makes 1/12 revolution; and when the driver makes another 1/16 revolution, the driven disk makes 2/12 revolution, or in other words, it travels just twice as fast as it does during the first 1/16 revolution of the driver.

In the case of the mechanism shown at the right, the driver makes 1/12 revolution, starting from point *B*, while the driven disk makes 1/60 revolution. When the driver makes another 1/12 revolution, the driven disk makes 4/60 revolution; or in other words, it rotates four times as fast as during the driver's first 1/12 revolution. Thus slow starting and stopping of the intermittent movements is a feature of these drives.



Diagrams Showing Two Drives of the Pin and Slotted Disk Type

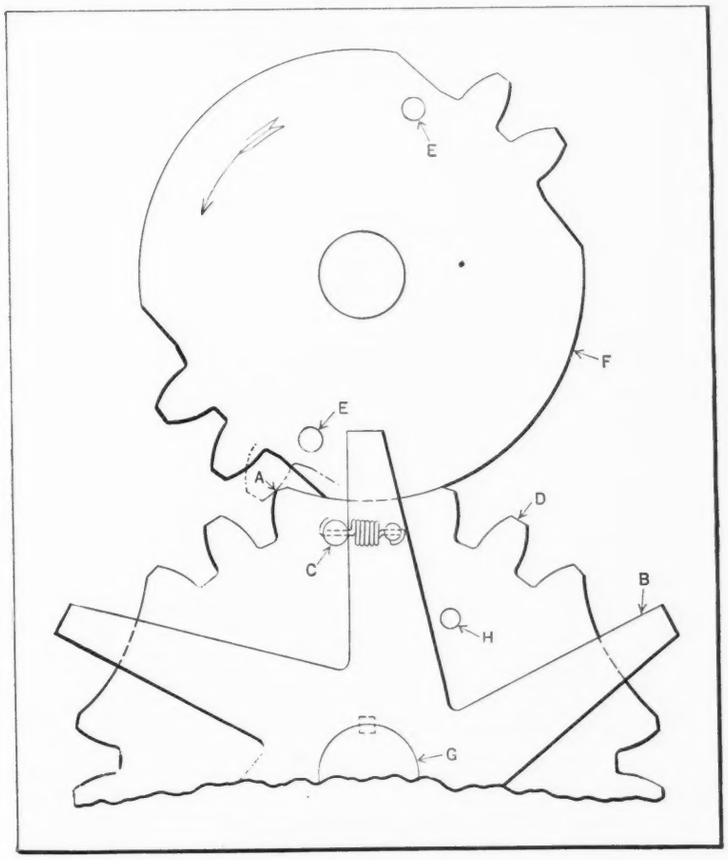
Shock Absorber for High-Speed Intermittent Gearing

By J. E. FENNO

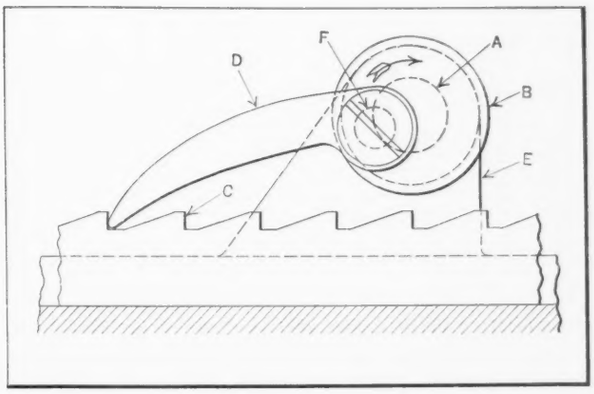
One of the greatest objections to the intermittent type of gearing when used for transmitting high-speed movements is the impact of the mating gear teeth at the beginning of each intermittent movement. This action is due, of course, to the inertia of the driven gear and the offset position at which tooth contact takes place, as indicated at *A* in the illustration.

The greater part of the wear, tooth breakage, and noisy operation resulting from the tooth impact is prevented by means of the arrangement shown. Here a steel spider *B* having as many arms as there are dwelling positions in the driven gear *D* is mounted on the shaft *G*. This spider, although free to rotate on the gear-shaft, is held normally by a coil spring against pin *C* in gear *D*. The movement of the spider on the shaft is limited by pin *H*.

Just before the tooth contact at *A* occurs, one of the pins *E* in gear *F* forces the top arm of the spider toward the right, causing the spring to exert a pull on pin *C* and start gear *D* gradually. Thus the inertia of gear *D* is overcome before the contact at *A* occurs; hence the force of the impact at the point of engagement of the teeth is greatly reduced.



High-speed Intermittent Gearing with Arrangement for Reducing Tooth Impact



Crank-driven Pawl that Imparts a Slow Movement at Both Ends of its Stroke to Prevent Jerking and Over-run

Ratchet Pawl Having a Slow Movement at Both Ends of Its Stroke

By F. E. JUDSON

A feed-slide in a special tube cutting-off machine is given an intermittent movement by means of a pawl engaging evenly spaced teeth on the slide. To eliminate jerking at the beginning and over-run at the end of each slide movement, the pawl was actuated by means of a crank, as shown in the illustration. Here the teeth on the slide are indicated at *C*, one of which is engaged with the pawl *D*. The pawl turns freely on pin *F* in the crank disk *B*. The disk is integral with the end of the continuously rotating shaft *A*, which turns in the stationary bearing *E*.

As the shaft *A* rotates in the direction of the arrow, the pawl is carried toward the right until it engages the next tooth. At this time the pin *F* is diametrically opposite the position in which it is now shown. Continued rotation of shaft *A* causes the slide to start very gently toward the left, owing to the curvature of the path through which the pin travels. The velocity of the slide, however, increases as the pin approaches the bottom of disk *B*, and decreases as it approaches the position shown, the movement at the end of the stroke being barely perceptible. Consequently, the momentum of the slide is greater at the middle of the stroke and decreases at the end of the stroke, so that no over-run of the slide occurs.

* * *

In a country full of natural resources, with a people having a remarkable capacity for production and educated to a high standard of living, business depressions are the result of artificial, not natural, economic causes.

Twist Drills and the Materials from which They are Made

A Review of the Steels Used in the Manufacture of Twist Drills, Together with Recommendations for the Most Efficient Use of These Tools

By W. R. BREELER, Metallurgical Engineer
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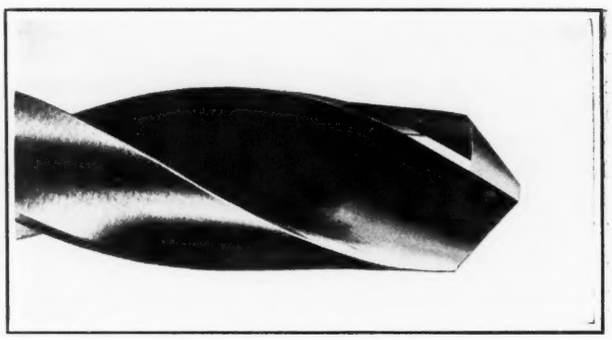


PRODUCTION executives often ask for information concerning the proper application of drills made from different steels. Misapplication results in low production, excessive tool cost, or both. The cutting ability of a drill or any other tool depends upon the physical, chemical, and metallurgical properties of the material from which it is made. Therefore, a knowledge of the properties of the various steels and alloys used in making twist drills is of definite practical value.

Starting with plain carbon tool steel, twist drills have been improved by the use of finishing, high-speed, and super-high-speed steels. Some progress has been made by applying tips of Stellite and tungsten or tantalum carbide to drills. The nitriding and chromium-plating processes have also been used to some extent.

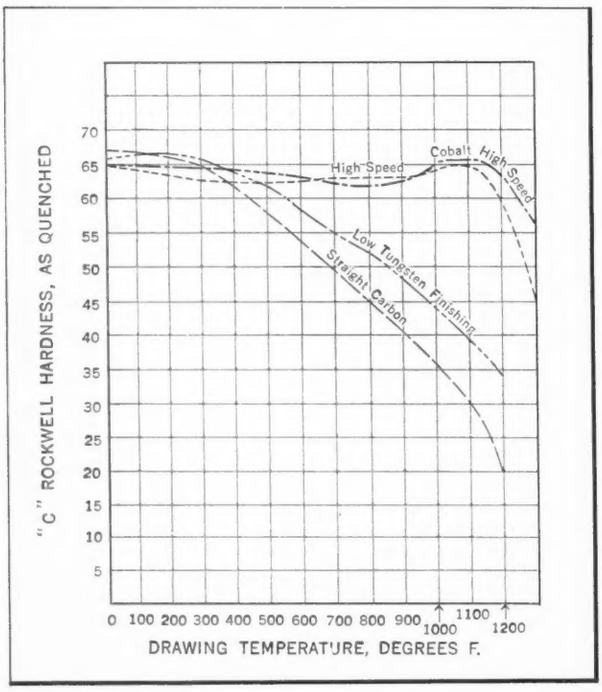


Fig. 1. Hardness after Tempering Representative Carbon, Finishing, High-speed and 11 Per Cent Cobalt High-speed Steels

Millions of Drills are Still Being Made from Carbon Steel

Carbon steel drills still fill a definite need and find widespread application. In view of all the developments made in cutting steels, it is surprising to learn that in 1929, according to the United States Department of Commerce, carbon steel drills to an approximate value of $4,000,000 were produced; in the same year, high-speed steel drills to an approximate value of $10,000,000 were made. Allowing for the difference in price, this indicates that in number of drills produced, there are approximately as many carbon steel as high-speed steel drills made.

A typical analysis of the carbon tool steel commonly used for drills is as follows: Carbon, 1.20 per cent; manganese, 0.25 per cent; phosphorus, 0.015 per cent; sulphur, 0.015 per cent; and silicon, 0.20 per cent.

Some drill manufacturers prefer to add chromium up to approximately 1 per cent. This increases the hardness penetration in the larger sizes and permits of oil quenching in the smaller sizes. Other drill steels contain up to 0.25 per cent of vanadium to add toughness and refinement of grain.

Carbon steel drills are hardened at temperatures between 1400 and 1550 degrees F., and quenched in water, brine, or oil, depending upon the size of the drill and the type of steel used. After quenching, the tools are tempered to a hardness of from 60 to 63 C. Rockwell. Drawing temperatures of from 350 to 450 degrees F. are generally used. If heated over 450 degrees F., carbon steels rapidly lose the hardness required to maintain a proper cutting edge for general work. (See Fig. 1 for tempering curve and Fig. 2 for hot hardness graph.) Therefore, to obtain reasonable tool life, carbon steel

drills should not be operated at cutting speeds high enough to soften the edges materially.

Table 1 gives the cutting speeds recommended for high-speed steel drills. Under ordinary conditions, carbon steel drills should be operated at about one-half the speeds recommended for high-speed steel drills.

Table 2 illustrates the difference in performance between 3/16-inch carbon and high-speed steel drills when operated in 1-inch thick S A E 1040 steel, the carbon steel drills being operated for test purposes at correct and at too high cutting speeds.

Carbon steel drills are used for drilling practically all of the more common materials encountered in everyday shop practice. While they are not recommended for high-production work, they are still used to an appreciable extent for production drilling on cast-iron stove burners, soft steel, brass, wood, and asbestos compositions. The low initial cost of these drills is, of course, a factor of considerable importance in maintaining a demand for them.

Drills Made from Low-Tungsten Tool Steels

There is an intermediate type of drill sold as carbon, super-carbon, or alloy tool-steel drills. Several typical analyses of the steels used for these drills are given in Table 3. These steels are generally known as "finishing" steels.

For these steels, hardening temperatures of from 1450 to 1600 degrees F. are used, followed by oil- or water-quenching. If water-quenched, the hardening heat is usually below 1550 degrees F. Finishing steels are characterized by high hardness as quenched (66 to 68 C. Rockwell) and by a fine dense grain. Finishing steels do not soften as readily as carbon steel when tempered.

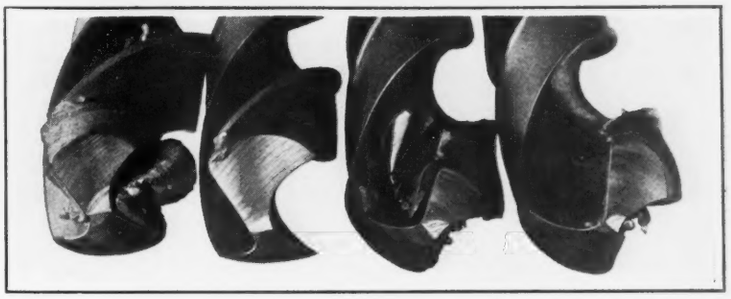


Fig. 3. How High-speed Steel Drills are Likely to Fail when Operated at Too High Speeds and Feeds

Drills made from finishing steels are used to advantage in place of plain carbon steel tools when increased cutting speed and longer life are required. They cannot, however, be compared with high-speed steel drills. The results of several steel drilling tests are given in Table 4. Representative commercial drills made from several of the alloys mentioned in Table 3 were compared with plain carbon steel drills. It will be noted that at the recommended carbon steel drill speeds, there is no appreciable difference in performance. At slightly increased speeds, the alloy-steel drill is much the better.

The tests recorded do not quite correctly represent the difference between finishing and plain carbon steel, since there was a small difference in the construction of the drills. However, the data appear to be fairly consistent and indicative of the trend. Whether or not the same relationship would hold true when drilling non-ferrous metals and other materials cannot be stated at this time.

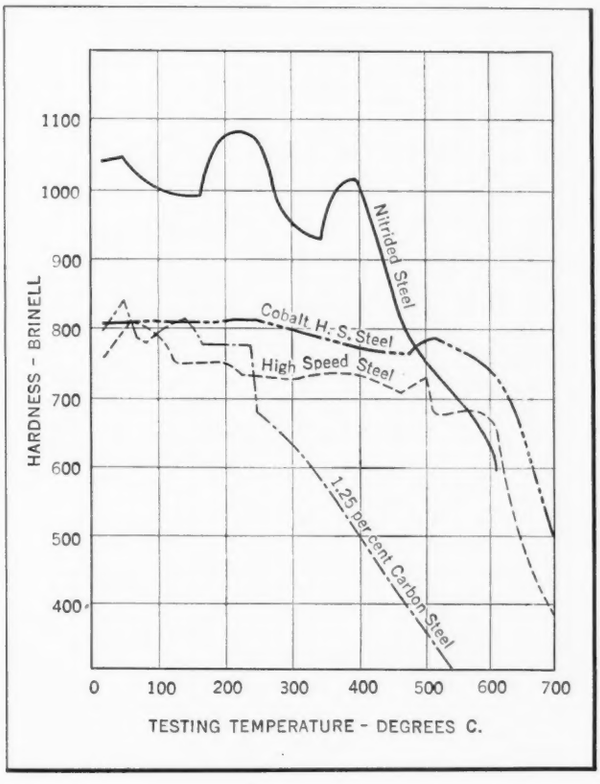


Fig. 2. Curves Showing Hot Hardness Values for Carbon, High-speed, 11 Per Cent Cobalt High-speed, and Nitrided Steels (From Data by E. G. Herbert)

For Production Work, High-Speed Steel Drills are Generally the Only Choice

The use of high-speed steel tools dates back thirty odd years to the experiments of Taylor and White. Since that time high-speed steel has been improved by increasing the percentages of carbon, tungsten, and chromium, and by adding vanadium. All the manufacturers of twist drills use practically the same analysis of high-speed steel. This analysis is approximately as follows: Carbon, 0.70 per cent; tungsten, 18 per cent; chromium, 4 per cent; and vanadium, 1 per cent. This steel is generally referred to as an 18-4-1 steel.

Steels with somewhat over 0.70 per cent carbon

Table 1. Recommended Cutting Speeds for High-Speed Steel Drills

Metal	Brinell Hardness Number	Speed, Feet per Minute
Cast Steel	.....	45
Malleable Iron	.....	85
Cast Iron (Soft)	Approx. 125	120
Cast Iron (Medium Hard)	Approx. 200	80
Cast Iron (Chilled)	Over 400	15*
Screw Stock (Cold-rolled)	.....	110
Machine Steel	.....	110
Tool, S A E, and Forging Steels	150	75
Tool, S A E, and Forging Steels	200	60
Tool, S A E, and Forging Steels	250	50
Tool, S A E, and Forging Steels	300	40
Tool, S A E, and Forging Steels	350	20
Tool, S A E, and Forging Steels	Over 400	15*
Chrome-nickel 18-8, Stainless Steel	.....	30
14 to 18 Per Cent Chromium Stainless Steel	.....	60
13 Per Cent Manganese Steel	.....	13*
Monel Metal	.....	50
Brass	.....	200
Bronze	.....	200
Aluminum	.....	250

*Use cobalt high-speed steel drills.

are generally used for small drills, while slightly less than 0.70 per cent carbon is used for the larger sizes. The 14 per cent tungsten high-speed steel is no longer used for drills. High-speed steels containing no tungsten, but instead approximately 7 per cent of molybdenum, have given very good results and are worthy of further investigation.

Drill manufacturers guard the heat-treatment of their product with considerable care. It is this part of the manufacturing process chiefly that determines the cutting quality of the tool. Briefly, high-speed steel drills are preheated at a temperature of from 1400 to 1600 degrees F. and are then transferred to a high heat of from 2300 to 2400 degrees F., after which they are quenched in oil or cooled in air. A tempering range of 1050 to 1150 degrees F. will usually result in a hardness of 61 to 64 C. Rockwell.

High-speed steel can be reheated to from 1100 to 1150 degrees F.; and after cooling to room temperature, will still show a hardness of over 60 C. Rockwell. It is partly due to this fact and to the important property of hot hardness that high-speed steel tools can be operated at high cutting speeds. Hot hardness, sometimes referred to as "red hardness," should not be confused with secondary hardness or hardness after reheating. The latter is measured when the steel is at room temperature. Red or hot hardness refers to the hardness at red heat (from 1000 to 1400 degrees F.).

High-speed steel drills are used commercially for drilling practically all kinds of materials—cast iron, steel, brass, aluminum, Bakelite, slate, wood, etc. They are especially used when high production and long life are required. Recommended cutting speeds are given in Table 1.

If the conditions are such that carbon steel drill speeds are sufficient for the purpose, high-speed steel drills are not economical to use, because the difference in performance, as compared with the carbon steel tool, does not compensate for the difference in price.

As in the case of carbon and super-carbon-steel tools, high-speed steel drills have their limitations as regards speed and feed. The effect of too high a cutting speed and too heavy a feed on four different makes of drills is shown in Fig. 3. The average high-speed steel drill is not commercially satisfactory for the majority of highly abrasive non-metallic materials or for hardened or work-hardening metals of an approximate hardness of 400 Brinell or more. It is not to be inferred from this that high-speed steel drills will not cut such materials; but in view of more recent developments in cutting tools, their use is not recommended for present-day high-production purposes.

Table 2. Comparison of Performance of Carbon and High-Speed Steel Drills

Type of Drill	Brinell Hardness No. of Steel Drilled	Speed, Feet per Minute	Feed per Revolution, Inch	Holes per Grind
Carbon Steel	131	37*	0.004	900
Carbon Steel	131	70†	0.004	200
High-Speed Steel	150	75†	0.004	1300

*Approximately correct speed for carbon steel drills
†Approximately correct speed for high-speed steel drills

In the preceding paragraph, certain limitations of high-speed steel drills were mentioned. By slightly increasing the percentages of carbon and of the alloying metals, and by adding up to 12 per cent of cobalt and 1 per cent of molybdenum, a super-high-speed steel is produced capable of withstanding higher cutting temperatures.

There are several cobalt high-speed steel drills on the market that find wide application in drilling hard metals which are beyond the capacity of ordinary high-speed drills. In resisting the action of abrasion, the cobalt high-speed steel drills, with

Table 3. Typical Finishing and Oil-Hardening Steels Used for Twist Drills

Brand	Composition, in Percentages						
	Carbon	Tungsten	Chromium	Vanadium	Silicon	Manganese	Molybdenum
A	1.07	1.36	0.07	....	....	....	....
B	1.08	1.89	0.50	0.32	....	....	....
C	1.23	2.70	0.60	....	....	....	....
D	1.25	3.25	0.50	0.20	....	....	....
E	1.03	0.20	1.20	Trace	1.00	....	0.95
F	1.12	0.62	0.96	....	....	1.35	....

their higher carbon and alloy content, are superior to those made from ordinary high-speed steel, but they cannot be compared with tungsten-carbide tipped tools.

The addition of cobalt to high-speed steel increases the red hardness and the resistance to tempering. In other words, cobalt high-speed steel drills can be subjected to higher cutting temperatures without destroying the edges.

After careful preheating, cobalt high-speed steel drills are hardened at temperatures of from 2400 to 2500 degrees F., and drawn at from 1050 to 1150 degrees F. Typical analyses of steels on the market are given in Table 5. It has been reported that several foreign brands of steel contain as much as 18 per cent cobalt.

Owing to the high carbon and alloy content, these steels are difficult to manufacture, and hence tools made from these steels cost the consumer considerably more than those made from ordinary high-speed steel. Present prices range from 75 cents to $2 a pound, depending upon the analysis. Cobalt high-speed steel does not become as soft in annealing as ordinary high-speed steel, and the machining of the drill blanks is more difficult and costly. The difference in performance between a cobalt and a regular high-speed steel drill must be carefully determined in order to decide whether there is any economy in using the more expensive tool.

The following examples illustrate the kind of materials for which cobalt high-speed steel drills are suitable. In a nickel-chromium-copper cast iron, 400 Brinell, a 7/8-inch cobalt high-speed steel drill cut 32 holes, 1 inch deep, at a speed of 80 revolutions per minute, with a feed of 0.010 inch, while a regular high-speed steel could cut but one hole per grind.

In a molybdenum-copper steel casting, 400 to 450 Brinell, a 3/4-inch cobalt high-speed steel drill, with a speed of 110 revolutions per minute and a feed of 0.005 inch, cut 20 holes, 1 3/16 inch deep, while a high-speed steel drill could cut but 4 holes per grind.

A white-iron casting, 512 Brinell, which could not be penetrated with a regular high-speed steel drill, was drilled successfully with a 3/8-inch cobalt high-speed steel drill at a speed of 176 revolutions per minute and a feed of 0.005 inch; 14 holes, 1/2 inch deep, were drilled without dulling the tool.

A five-ply laminated safe steel, two 1/8-inch layers of which were 650 Brinell, was drilled with a 7/16-inch cobalt high-speed steel drill at 264 revolutions per minute and a feed of 0.005 inch. Ten holes were drilled per grind.

In a 12 per cent manganese steel, 1 inch thick, a 15/16-inch cobalt high-speed steel drill produced 32 holes per grind at 46 revolutions per minute, with a feed of 0.005 inch, while a high-speed drill could drill but one hole per grind. Other favorable reports are available concerning cobalt high-speed steel drills operating in marble, stainless steel, and magnet steel.

The field for super-high-speed steels is increasing. Several recent reports show that cobalt high-speed steel tools of very high carbon content, subjected to special heat-treatment, have been able to do the work of Stellite and tungsten carbide on work for which the latter tool materials were previously the only ones that had proved satisfactory.

With the introduction of the cemented tungsten and tantalum carbides, a great advance has been made in the art of machining metals. Since there is so little data available on tungsten- and tantalum-carbide twist drills, no attempt will be made to differentiate between the two materials; both will be discussed under the one heading of tungsten carbide.

Table 6. Analyses of Typical Nitriding Steels

Steel No.	Composition, in Percentages					
	Carbon	Aluminum	Chromium	Molybdenum	Silicon	Vanadium
1	0.40	0.80	1.60	....	....	....
2	0.35	1.00	....	0.90	....	....
3	0.27	....	1.50	....	....	0.50
4	0.37	1.06	1.07	0.19	0.15	....

Table 5. Analyses of Typical Cobalt High-Speed Steels

Brand	Composition, in Percentages					
	Carbon	Tungsten	Chromium	Vanadium	Cobalt	Molybdenum
A	0.75	19.00	4.25	1.10	3.00	....
B	0.75	19.00	4.25	1.10	6.50	....
C	0.75	19.00	4.75	1.00	9.00	....
D	0.80	21.00	4.50	1.25	11.00	0.50

Table 4. Comparison of Performance of Carbon and Finishing Steel Drills

Drill Size, Inch	Type of Drill	Hardness of Drill, Rockwell	Steel Drilled	Brinell Hardness of Steel Drilled	Hole Depth, Inches	Speed, Feet per Minute	Feed, Inch	Holes per Grind
3/8	Carbon Steel	60	S A E 1040	150	2	39*	0.005	115
3/8	Brand E†	60	S A E 1040	150	2	39	0.005	117
3/8	Carbon Steel	60	S A E 1040	150	2	50	0.005	42
3/8	Brand E†	60	S A E 1040	150	2	50	0.005	84
3/16	Carbon Steel	60	S A E 3240	255	1/2	25*	0.005	100
3/16	Brand A†	60	S A E 3240	255	1/2	25	0.005	98
9/16	Carbon Steel	61	S A E 1040	150	2	41*	0.008	51
9/16	Brand F†	61	S A E 1040	150	2	41	0.008	53

*Approximately correct speed for carbon steel drills †See Table 3

The carbide alloys are probably better known by their trade names, a few of which are Carboloy, Widia, Ramet, Carmet, Strauss Metal, and Firthite. A representative analysis of one type is as follows: Carbon, 5.3 per cent; tungsten, 81.4 per cent; cobalt, 12.7 per cent; balance, iron. As is well known, for cutting tools tungsten carbide is used in the form of a tip or insert, which is brazed or mechanically held to a shank. The heading illustration shows one method of tipping twist drills.

The extreme hardness of tungsten carbide makes it especially resistant to abrasion and wear. The cutting edge will not soften when operated at high speeds. Its hot-hardness value is far above that of any tool steel or alloy. Its compressive strength is greater than that of any other known material. It is more than twice as hard as the hardest high-speed steel, but it has only about one-half the transverse strength.

Present Applications of Tungsten-Carbide Tipped Drills

While tungsten carbide has been used extensively for lathe tools, milling cutters, counterbores, and other tools, tungsten-carbide drills have found only a limited application. Possibly the conventional construction of a twist drill does not provide the rigidity and support necessary to drill materials of high tensile strength. For non-metallic materials, such as Bakelite, Textolite, hard rubber, Celeron, Pyralin, Fabroil, glass, graphite products, slate, and granite, tungsten-carbide twist drills, under proper operating conditions, have proved very satisfactory. In rubber, Bakelite, Fabroil, asbestos, and wood compositions, extremely high speeds can be used without dulling or burning the cutting edge.

One report shows that a tungsten-carbide drill, operating in ebony asbestos at 66 per cent greater speed and feed than a high-speed drill, gave ten times more holes per grind. Although no actual reports are at hand, it is probable that tungsten-carbide drills can be used successfully and economically for non-ferrous metals as well.

The application to ferrous metals, however, has not been successful on a commercial scale. However, laboratory experiments have shown promising results in both cast iron and steel. With changes in drill design, improvements in drilling machines, and methods of applying or holding the tungsten-carbide tip, it is probable that tungsten-carbide drills will soon find commercial application for drilling cast iron and steel as well.

Drilling with Stellite

Drills tipped with Stellite or other high-chromium-cobalt-tungsten alloys have not been used commercially to any great extent. Non-ferrous metals and cast iron, however, have been drilled with Stellite in a few instances. In one case, a Stellite-tipped core drill gave ten times the performance of a high-speed steel drill in cast iron.

Stellite drills are usually made by butt-welding solid cast Stellite tips to carbon steel shanks. The flutes of the shank are then welded with Stellite the full length, in order to maintain the drill size and prevent seizing in the bushing. A 15-degree spiral has been found satisfactory. This makes it possible to use a Stellite tip of comparatively heavy section.

An indication of the possibilities of Stellite-tipped drills may be obtained by a study of the properties of this metal. Stellite compositions have a Brinell hardness of between 500 and 600. The hot hardness of the grade commonly used for cutting tools is greater than that of high-speed steel at temperatures over 500 degrees C. (about 930 degrees F.). This value, however, is considerably below that of tungsten carbide.

Hence, Stellite compositions will stand higher cutting speeds and temperatures than either the regular or the super-high-speed steels. This fact has been substantiated by commercial tests. Owing to their pronounced resistance to wear and abrasion, Stellite-tipped drills may also find commercial application for drilling Bakelite, hard rubber, and similar materials at high speeds.

Applying the Nitriding Process to Cutting Tools

Within the last few years, the application of the nitriding process to cutting tools has received considerable attention. Although still in the development stage, nitrided twist drills have, in several instances, proved commercially satisfactory for use on non-metallic materials, such as Bakelite and hard rubber. Table 6 gives the analyses of a few of the most common types of nitriding steels. For twist drills, however, regular high-speed steel—or, better yet, a high-speed steel containing an appreciable percentage of molybdenum—is looked upon with favor because of its red hardness value and its tendency to maintain high hardness after the nitriding treatment.

The average nitrided case has a hardness of about 1000 Brinell and maintains this hardness even at temperatures up to 400 degrees C. (about 750 degrees F.). Between 400 and 600 degrees C. (750 to 1100 degrees F.) the hot hardness decreases, but is still greater than that of high-speed steel. Above 600 degrees C. (approximately 1100 degrees F.) the hot hardness is about the same as that of high-speed steel. Reheating a nitrided surface up to 1000 degrees F. will not affect the hardness when measured at room temperature. The abrasion and wear resistance of nitrided steel is greater than that of hardened high-speed steel, but is not so great as that of tungsten carbide.

The properties of nitrided steel, as recorded above, account for the performance records of nitrided drills in abrasive non-metallic materials of low tensile strength. However, for ferrous and non-ferrous metals, nitrided drills have not yet proved of any decided advantage. In most cases, the hard nitrided cutting edge chips and causes early failure.

Chromium-Plated Cutting Edges for Drills

Like the nitriding process, chromium-plating has been used only to a limited extent for twist drills. This may seem strange, since chromium-plating has been applied to many other tools with favorable results. Chromium surfaces are quite brittle, but nearly as hard as tungsten carbide. Their resistance to abrasion and their low coefficient of friction are desirable qualities for cutting tools.

The best results up to the present time have been obtained by applying 0.0002 to 0.0003 inch thick chromium deposits to high-speed steel drills. Heavier deposits have been applied, but to no advantage. In fact, too thick a chromium deposit tends to cause chipping at the cutting edge.

It has been reported that chromium-plated drills have been used to advantage in abrasive non-metallic materials, such as Bakelite, slate, and porcelain. For general cast iron and steel drilling, however, they have not yet proved to have any advantage over high-speed steel drills.

What is Wrong with Drafting-Room Standards?

By WALTER S. BROWN

The points raised in the articles "What is Wrong with Drafting-Room Standards?" page 415, February MACHINERY, and "Obsolete Traditions in the Drafting-Room," page 524, March MACHINERY, call for comment. In the writer's opinion, the author of these articles has exaggerated the tendency of some drafting-rooms to over-emphasize details, and underrated the average draftsman's ability to assimilate variations of method in different drafting-rooms. With the larger organizations, especially when there are several plants, the system tends to become rather elaborate; but it is practically never the business of the draftsman, designer, or detailer to learn more than a small part of it. Generally, an intelligent man who enters into the spirit of the system, is at home inside of two weeks with the part of the system that concerns him.

A reasonable standardization of notes for drawings is necessary as a means of insuring that all essential information be put on the drawing. It also enables the shop men to more readily locate the notes that concern each man. Furthermore, one must remember that the rising generation requires some standard for guidance. To rely on the checker to catch errors and freakish work is fundamentally erroneous. Often there is no individual checker, but the checking is done by the section leader, and his time is too valuable to be spent on matters of this kind, when they can be easily avoided by following a standard practice. While there are instances of antiquated practice, drafting-room procedure generally is the result of careful thought on the part of well trained men.

Should one write or print on drawings? This is largely a matter to be decided in accordance with the class of work involved. In jobbing shops, where no serious attention need be given to the matter of records, written instructions are satisfactory. In the building of complicated machinery, which may remain from ten to thirty years in service and require replacement parts throughout its life, a different procedure is advisable. Drawings are records of great importance, and it is not time wasted to have them carefully executed. Usually, the time spent in actual drawing and printing is a very small percentage of the total time required in carrying out the design from its inception up to the time that it finally leaves the drafting-room.

Reasonably well planned and well made drawings enable the draftsman himself to visualize his work to better advantage and to place his dimensions where they will most easily be found by the user of the drawings. Few shop men have had any real training in reading drawings; and where piecework systems are in vogue, the demand for easily read drawings is still more imperative. *Good* writing may meet the requirements just as well as printing, but few draftsmen can write well without a great deal of effort. They can learn to print much more easily, and the printing is more compact.

It pays to put thought into the execution of a drawing. Such thought soon becomes second nature and requires very little additional time. Is it not poor economy to save a small part of the draftsman's time at the expense of unsatisfactory drawings, which continuously waste the time of many other people?

As a conclusion, the writer would like to modify a quotation from one of the articles referred to as follows: "Let us keep in mind that the mechanical draftsman's job is to produce drawings that will convey to the shop quickly, easily, and repeatedly, clear pictures of machine equipment, with concise but full instructions."

* * *

There are two sides to every question. Much has been said about senseless selling at prices that cannot cover costs and the responsibility of the seller for these conditions. This responsibility, however, must be shared by the buyer, who in many cases uses present market conditions to force prices down to an uneconomical level. Many business firms have become aware of the dangers of destructive buying, even when they themselves might profit from extremely low prices, and of late, efforts have been made to check the evil influences of uneconomical selling and destructive buying.

Special Tools and Devices for Railway Shops

Recommended by Railway Shop Superintendents and Foremen

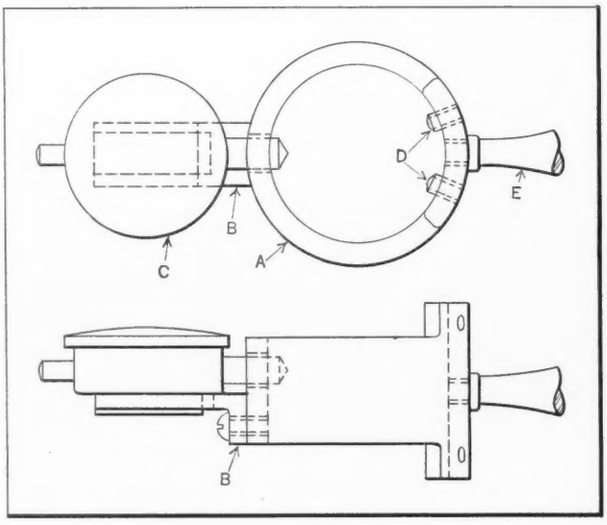
Indicating Device for Detecting Worn Spots on Piston-Rods

By E. G. JONES, Atlantic Coast Line Railroad Co. Tampa, Fla.

It is the practice in the air-brake department of one railroad repair shop to put back into service the old steam pistons that have been removed from pump cylinders that are to be rebored. Practically no machining is required in salvaging these pistons, except when the rods are worn in spots or grooved. An ordinary micrometer or caliper is of little assistance in determining the accuracy of the rods, and if a worn spot is overlooked, steam will escape at this point.

To facilitate the checking of these rods, the writer developed the indicator shown in the illustration. This consists of a brass ring *A* to which is fastened the forked angle-bracket *B*. On the bracket is mounted, by means of a spring clip, the dial indicator *C*, which has a movable face. At one side of the ring are four hardened screws *D* which serve as measuring points in checking the rods. A handle is provided for the device, as shown at *E*.

In use, the ring is slipped over the end of the rod, which should be in a vertical position. The four points of screws *D* are held snugly against the rod and the indicator, which has previously been set and clamped so that the indicator bearing point is compressed about 1/8 inch. The movable dial face of the indicator is now moved so that it registers zero, and the device is then moved up and down the piston-rod until the entire surface of the rod is checked. Any worn or grooved spots will be quickly detected by the movement of the dial hand from the zero point. Obviously, with the four-point contact thus provided, the entire surface of the rod can be checked in a short time. A master plug or an accurate rod should be used in setting the screw points. Practically any type of dial indicator can be used with this device.



Indicator for Detecting Worn Spots on Piston-rods

* * *

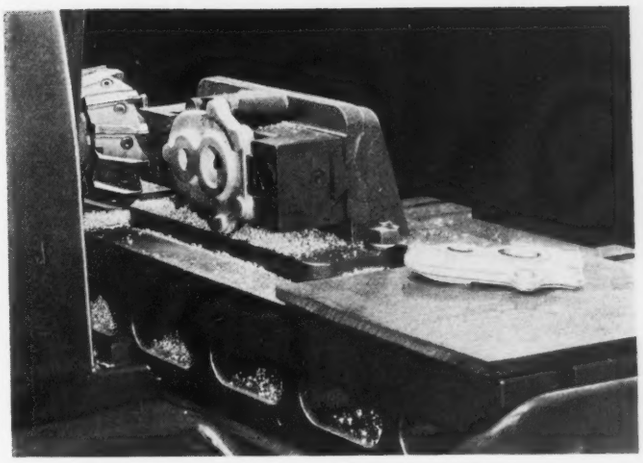
Railway Car with Rubber Tires

The London, Midland and Scottish Railway Co. and the Michelin Tire Co. recently carried out tests with the first car in England to run on rails with pneumatic tires. The tests took place over about thirty-one miles of track, and excellent results were obtained.

The Michelin railway car sounds an entirely new note in methods of rail transportation, the most striking departure being the use of rubber tires on rails. A remarkable smoothness of running is obtained, as well as an increased adhesion to the rails. A running speed of 60 miles per hour was easily obtained, and a speed of 50 miles per hour was attained from a standstill in 650 yards.

Due to the small area of contact with the rails, nothing was gained by using giant tires; but in order to carry the load successfully with smaller diameter tires, the number of axles was increased to five with a total of ten wheels. In consequence, braking is very smooth and effective, as brakes are fitted to all the wheels. Should any one of the tires become deflated below the regulation pressure of 90 pounds per square inch, a "hooter" notifies the motorman of the fact.

Milling with Carbide Insert Cutters



Points on Grinding Tungsten-Carbide Cutters—Examples of Aluminum, Cast Iron, and Steel Milling—Second of Two Articles

By FRANK W. CURTIS, Research Engineer
Kearney & Trecker Corporation, Milwaukee, Wis.

IN the first article of this series, published in May MACHINERY, page 685, the advantages to be gained by using tungsten-carbide milling cutters were pointed out. The questions "Can tungsten-carbide milling cutters be used successfully in present machines?" and "Are tungsten-carbide cutters applicable only to high-production milling?" were answered. Important features in successful tungsten-carbide milling were emphasized and some rules given to be followed in the use of carbide cutters. The present article will deal with the grinding of tungsten-carbide milling cutters and with the milling of aluminum, cast iron, and steel.

The Grinding of Tungsten-Carbide Milling Cutters

Every now and then tungsten-carbide milling is pronounced unsuccessful because of apparent difficulties in sharpening the cutters. These difficulties are more imaginary than real. True enough, there are some points to be observed and care must be exercised in grinding, but there are no perplexing problems. When any new practice is introduced, it is necessary to learn something new. That applies to the use of tungsten-carbide cutters as much as to anything else. The following points should be carefully observed in grinding tungsten-carbide cutters:

1. Use a cutter grinder that is of suitable size and is in good condition. A new grinder is to be preferred. Be sure that there is little or no end play in the wheel-spindle and that the slides are not loose or worn to a point where they "wobble." If an old cutter grinder is used, inspect all sliding and rotating parts and make any adjustments or repairs needed.

2. Use the correct grade of abrasive wheel. Many failures are traced to the use of incorrect wheels, because little thought has been given to their importance. The wheel should be "free-cutting," of the recommended structure, and be kept dressed. The grade and grain should be those best suited for the type of carbide being ground. The makers of the tungsten- or tantalum-carbide will specify this. Wheel manufacturers have also issued booklets cov-

Fig. 1. Milling Aluminum Level Bodies with a Table Feed of 100 Inches per Minute

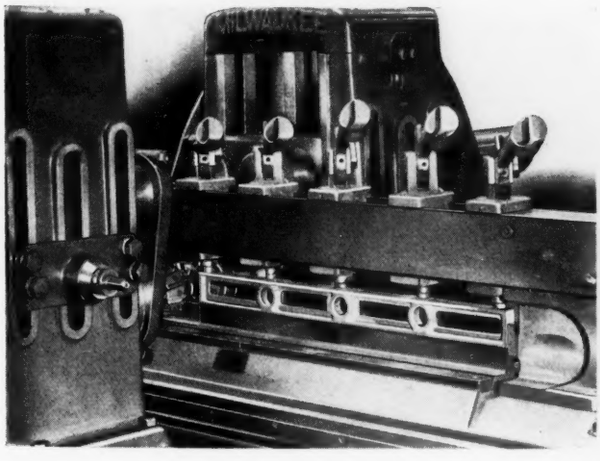
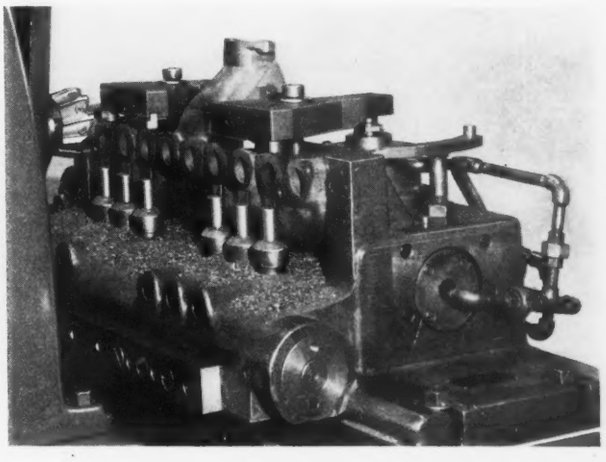


Fig. 2. Cast-iron Manifolds which are Milled at a Cutting Speed of 300 Feet per Minute



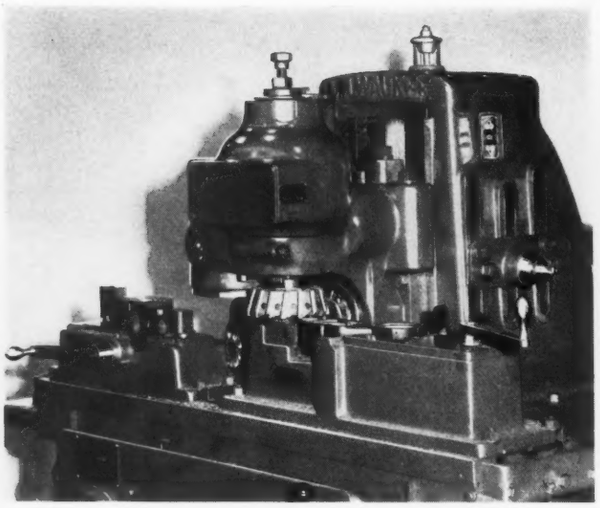


Fig. 3. A Cast-iron Oil-cooler Body on which Three Cuts are Taken Simultaneously with a Feed of 26 Inches per Minute

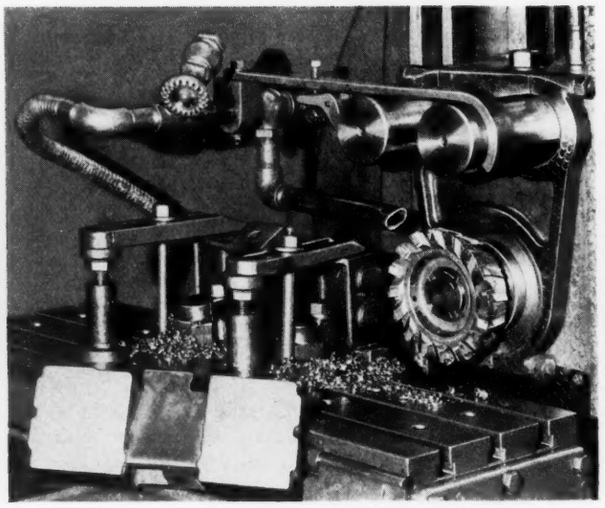


Fig. 4. Milling a Cast-steel Bracket at a Cutting Speed of 200 Feet per Minute, with a Feed of 13 Inches per Minute

ering the grinding of carbide tools, giving the necessary wheel data.

3. Sharpening of the cutters should be done with great care until the proper "feel" is acquired. More than 0.0005 inch at a pass should not be removed. Half this amount will often suffice. Pass the wheel back and forth across the face of the blade with a steady motion. Be sure that the cutter is held firmly while the wheel is in contact with it. Always rotate the wheel so that it grinds *down* from the cutting edge.

4. Inspect the cutter before it is removed from the machine. A dial indicator can be used satisfactorily, and can be mounted without much difficulty on practically all styles of cutter grinders. Its use will assist in obtaining uniformly ground blades.

5. The limits of accuracy for sharpening carbide cutters depend on the nature of the finish required, but for general-purpose work, where a good finish is wanted, the faces of the blades should be kept within limits of 0.0005 inch. Keep the outside diameter uniform within 0.0015 inch.

6. Whenever possible, sharpen cutters 3 to 7 inches in diameter on the arbors used with them. There is a chance of misalignment in changing from one arbor to another, and the care taken in sharpening may be useless, because excessive "run out" may develop when the cutter is mounted in the machine. Cutters 8 inches in diameter and larger are usually aligned from the spindle face by a centering plug on the spindle nose.

7. Tungsten-carbide cutters should not be allowed to become too dull. When the cutting edges are badly rounded or worn, the sharpening time is unduly increased. If more than 0.005 inch has to be removed from any cutting edge, the cutter has been allowed to operate too long (unless too high a speed has been used or excessively hard material is encountered). Usually from 0.003 to 0.004 inch removed from the faces of a set of blades should be all that is needed to restore sharp cutting edges.

Milling Aluminum with Tungsten-Carbide Cutters

Tungsten-carbide cutters, as is well known, are especially suitable for milling aluminum. Fig. 1 shows an example of the milling of aluminum level bodies. Formerly these levels were ground on a disk grinder, followed by two polishing operations and a finish-honing operation. On account of the heat generated during polishing, the bodies had a tendency to warp, which necessitated a straightening operation.

The adoption of tungsten-carbide milling for this operation has made it possible to produce an unusually smooth finish, which has eliminated the two polishing operations, and because of the small amount of heat generated during the milling, the straightening operation also became unnecessary. The surfaces are simply milled and then honed. Furthermore, the aluminum chips are salvaged and sold.

The fixture shown accommodates levels varying from 12 to 42 inches in length. Both sides are milled at one time, and the levels are then located on their sides, two at a time, for milling the top and bottom surfaces. The cutters are 4 inches in diameter, and are operated at 1000 revolutions per minute. The table feed is 100 inches per minute, and the depth of cut varies from 1/32 to 1/16 inch. All surfaces are finished in one cut. Note the heavy construction of the fixture.

The heading illustration shows the milling of an aluminum cover with a 6-inch cutter operating at

a cutting speed of 1200 feet per minute. The depth of cut is approximately 1/16 inch, and the table feed 85 inches per minute.

Milling Cast Iron with Carbide Cutters

The milling of cast iron, of course, is a simple job. Most carbide cutter milling, up to the present, has been performed on cast iron. Fig. 2 shows a set-up for milling a cast-iron manifold. The cutting speed is 300 feet per minute, the table feed 32 inches per minute, and the depth of cut from 1/16 to 3/32 inch. Note, again, the heavy fixture design.

A cast-iron oil-cooler body is shown being milled in Fig. 3. In this case, the machine is equipped with three spindles—two horizontal and one vertical. One 7-inch and two 4-inch cutters are used, operating at 275 surface feet per minute, with a table feed of 26 inches per minute. Approximately 3/32 inch of stock is removed from each side of this part. The life between grinds varies from 1500 to 2000 pieces.

The two fixtures shown on the machine are of the quick-operating type. First, the part is placed in the fixture at the right of the table, and is aligned, located, and clamped by a single handle. The fixture at the left-hand side of the table is used for machining the opposite side of the part, and here, again, a single handle operates the locating and clamping means.

A step milling operation on a vertical machine is illustrated in Fig. 5, where a cast-iron magneto bracket is being milled. The cutter is operated at 305 surface feet per minute. The table feed is 26 inches per minute. Two surfaces at different heights are completed at one setting.

The Milling of Steel has Proved Feasible

The use of tantalum carbide for machining steel has developed rapidly, and at present it is possible to mill many steel parts with great speed. From experiments conducted up to the present time with face-milling, the main limitation seems to be the depth of cut. When the cut does not exceed 1/8 inch, the results have been favorable, but beyond this, chip interference and the limitations of tantalum carbide cause difficulties. On light finishing and semi-finishing cuts, however, tantalum-carbide milling has remarkable possibilities.

Fig. 4 shows the milling of a cast-steel bracket on which 3/32 inch of metal is removed at a cutting speed of 200 feet per minute and a feed of 13 inches per minute. The cutter is 7 inches in diameter and is of the same general construction as cutters used for cast iron, with the exception that the cutting angles are changed to suit the requirements of steel cutting.

It is reasonable to believe that the use of tantalum carbide for cutting steel will develop rapidly and that the limitations now apparent will be overcome. Recently, tungsten-carbide materials with improved binders have been brought out that also give promise of cutting steel successfully.

Fig. 5. A Step Milling Operation on a Cast-iron Magneto Bracket Performed with a Tungsten-carbide Milling Cutter

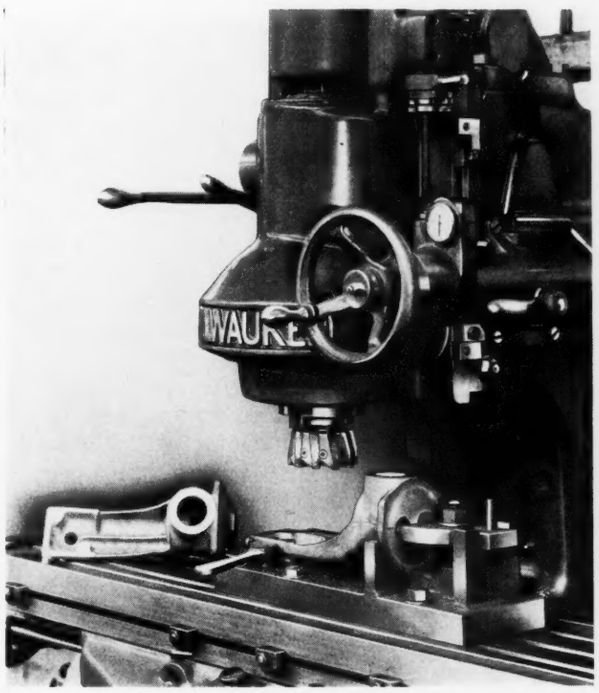
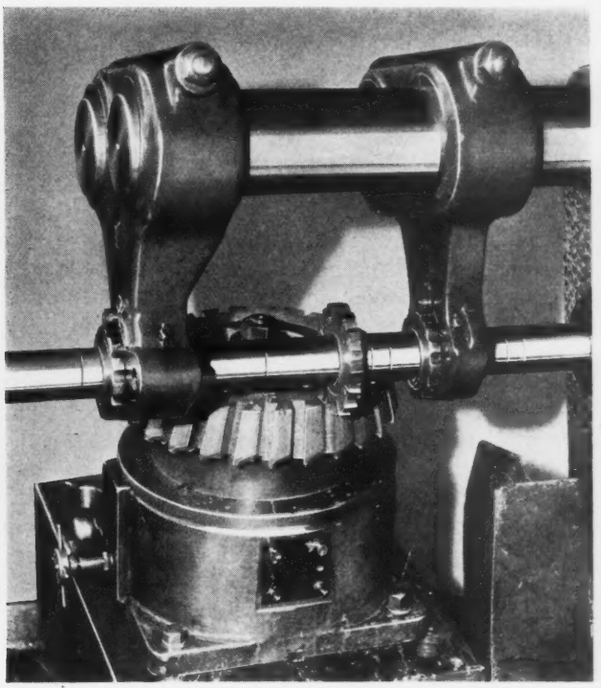


Fig. 6. Finish-milling Slots in Steel Cutter Bodies with a Tantalum-carbide Cutter at a Speed of 190 Feet per Minute



The Use of Solid Cutters with Carbide Inserts

While solid cutters with tungsten-carbide inserts are not so common as the inserted-blade type, there are cases where they can be used to advantage. Such an operation is illustrated in Fig. 6, which shows the finish-milling of slots in cutter bodies with a 9/16- by 4 1/2-inch tantalum-carbide cutter. The material is S A E 3140 steel which has been carburized. The slots have previously been roughed out so that in this last operation only 1/16 inch of material is removed from the two sides and the bottom of each slot. The cutter runs at a speed of 190 feet per minute and the table feed is 6 inches per minute. A slow feed is necessary to produce the fine finish required. In comparison with the cutter formerly used, the life between grinds has been doubled. The speed and feed employed are double those previously used.

The cutter used for this operation was made by tack-welding small inserted blades to a carbon-steel body. Each blade has a tantalum-carbide tip brazed to it before being welded in place. In the event of damage to one tip, the blade can be pressed out and replaced without affecting the other cutting edges. This form of construction is considered superior to designs where several tips are brazed directly to a single steel body. Keyway cutters, 5/16 by 2 1/2 inches, made as described have given good results.

* * *

Bronze-welding is being used successfully for repairing castings of all sizes. A typical example of this work may be mentioned. The two-ton plunger of the largest press in one plant cracked in two directions and the plunger guide broke in two. The repair was made as follows: First, the sides of the cracks were beveled. Then the casting was covered with asbestos paper to exclude drafts while welding and to prevent the weld metal from cooling too rapidly. Before welding, the cracks were preheated slightly by means of a blow-torch. Welding was started from the inner end of each fracture, as it was thought that the excess heat would be carried outward and set up less internal stress during cooling. After welding, the entire casting was covered with asbestos paper and allowed to cool. The cooling required six hours, after which the casting was once more placed in service and found to be as good as new. The entire cost of the job was less than one-fifth of the estimated cost of replacing the plunger with a new casting.

Precision Boring with Diamond and Cemented-Carbide Tools

Difficulty is nearly always experienced in attempting to machine bronze, Bakelite, aluminum, and similar materials with tools of the type ordinarily used for iron and steel, especially when a high finish is required. A process for producing accurate and highly finished holes in parts made from these materials will be described in July MACHINERY. In this process, diamonds and tungsten-carbide tools have been found to be the most satisfactory cutting materials. They operate at spindle speeds ranging from 2500 to 5000 revolutions per minute. At such speeds, boring and turning operations can be performed rapidly, even though very light feeds are used. The light feeds, however, prevent distortion of the work and deflection of the boring-bar, which results in the production of accurate highly finished holes.

An Expression of Appreciation

I, and all workers in the machine and allied industries, should thank MACHINERY for its straightforward presentation of the true facts in the editorial in the May number, "Why Don't We Stop Blaming the Machine for Our Troubles?"

How many are willing to go back to the "horse era" and its discomforts? Many of those who ride in modern automobiles, push buttons to obtain every service now available, and enjoy every comfort that engineering has created rave most loudly about our high-speed manufacture, claiming that it causes unemployment and suffering.

The editorial hits the nail right on the head with the statement that our troubles are not caused by present engineering methods and highly developed machinery; our economic difficulties are due to lack of intelligence and good will.

Employers and employes alike should read this editorial and should each do their share to stop this foolish prattle about the evils of modern machines. A semblance of prosperity can be brought back, not by changes in engineering methods, but by changes in the methods of economics.

CHARLES R. WHITEHOUSE
Boston, Mass.

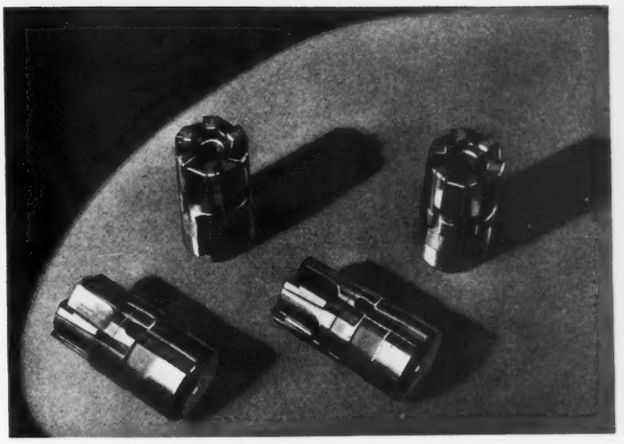
* * *

Hard-Surfacing of Shear Blades

With the development of alloy steels, many new problems have been introduced into the shop. A recent number of *Oxy-Acetylene Tips* cites a case where a small shear was used in a plant doing a considerable amount of plate work. The shear was entirely adequate for the needs of the shop until the advent of stainless steel. When plates of this material were cut in the shear, the blades were literally "chewed to pieces" in a very short time. As a result, frequent replacements were necessary, time was lost, and the finish on the edges of the sheared plates was not satisfactory.

It was decided to try hard-surfacing of the blades in order to reduce the wear to a minimum. Both edges of the shear coming in contact with the stainless steel sheets were coated with a thin layer of Stellite. This hard-surfaced shear has been used approximately two hours a day during the last two years for cutting stainless steel, and so far, very little wear can be noticed. While no accurate records were kept of the life of the untreated blades, there is no question but that the hard-faced blades have already outlasted quite a number of ordinary blades.

Boring—An Ideal Application of Tungsten Carbide



By R. R. WEDDELL
The O. K. Tool Co., Inc., Shelton, Conn.

OUTSTANDING economies result from the use of tungsten carbide for boring operations. Tungsten-carbide multi-blade boring or facing tools can best be constructed with inserted blades. This permits resizing and easy replacement of the blades. However, this construction is limited to the larger sizes of tools, say 1 1/2 inches in diameter and up, depending on the blade design.

The method of holding the blades should be such that adequate strength is provided in the body for backing up the blades. If possible, the tungsten-carbide tips should not extend into the blade slot nor rest against the clamping members, as they are likely to crack under these conditions. An important point in the design of boring tools of this type is the chip clearance. This may be obtained by grooving out the bar adjacent to the front of the blades.

The heading illustration shows a group of small tungsten-carbide tipped boring tools of the inserted-blade type. Note how well the blades are backed up. The backs of the blades rest against the body, which thus directly absorbs the shock of the cut. In front of the blades is a wide flattened groove to insure generous chip clearance. Owing to the small diameter of these tools, it was necessary to allow the tip to extend into the blade slot. The drive is more than adequate. The outside of the cutter body is ground, and serves as a pilot.

Cutting Angles Vary with Different Materials

The cutting angles of these boring tools vary with the material being cut, and are made less than for ordinary cutting steels in order to increase the strength and life of the cutting edge. In the accompanying table are given the cutting and rake angles recommended for various materials. These angles are indicated in Fig. 1. Note the absence of rake for the most popular applications of tungsten carbide, namely, the machining of cast iron, brass, and bronze. Rake should be used only when cutting the softer materials. Although rake materially reduces the power required for cutting, it also reduces the so-called contained angle. As a result, the strength of the tool is impaired.

The clearance angle is held to the minimum for the same reason. In fact, a small land at the point of clearance adjacent to the cutting edge is effective in increasing the strength of the cutter. Too great a land, however, will cause dragging, the use of excessive power, and noise in operation.

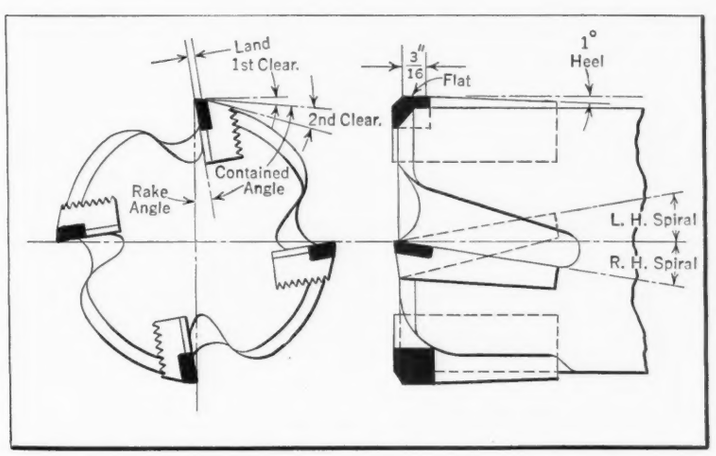


Fig. 1. Boring-bar with Tungsten-carbide Tipped Blades

Recommended Cutting Speeds and Feeds

General cutting speeds for tungsten-carbide boring tools are tabulated in the following:

Cast iron	200 to 250 feet per minute
Brass	300 to 400 feet per minute
Bronze	250 to 350 feet per minute
Aluminum	1500 feet per minute

Feeds are rather difficult to specify, as so many factors aside from the design of the tool are involved. For cast iron, a chip of 0.002 to 0.005 inch per tooth may be taken. Multiplying the chip per tooth by the number of blades will give the feed per revolution. Multiplying the feed per revolution by the number of revolutions per minute of the cutter will give the feed

in inches per minute. Whether the work, the fixture, or the machine tool will "pull" the cut is a matter for experiment. Here, also, chip clearance is a factor in determining the proper feed.

A boring tool for simultaneously machining the tapered bore and facing the hub of a radiator section is shown in Fig. 2. On the body *A* is mounted the facing head *B*. The facing head is adjusted laterally by the nuts *C* and is locked in position relative to the diameter of the tapered bore by the screw *D*. The drive to the taper head is obtained through the keys *E*, and the drive to the facer through the key *F*. The blades are tipped with tungsten carbide. The taper on the boring blades necessitates a long tip, the full length of the blade. The radiator facing is very narrow, thus permitting the facing tips to be secured in the blades on three sides. These blades are well backed up, yet they have considerable chip clearance.

Tungsten-Carbide Cutter Angles for Boring Various Materials

Cutter Angles	Angles, in Degrees, for Boring Cast Iron, Brass, and Bronze		Angles, in Degrees, for Boring Aluminum	
	Rougher	Finisher	Rougher	Finisher
Rake	0	0	10	10
First Clearance	2	1*	4	2 to 4
Second Clearance	4 to 6	4 to 6	6	6
Spiral	0	0 to 5 L.H.	15	15

*Land = 1/64 inch

* * *

Hyatt Roller Bearing Co. Celebrates Fortieth Anniversary

Back in 1892, John Wesley Hyatt, after years of experimental and development work, put the first Hyatt bearings into actual production. From a small beginning, the business has grown to become an important factor in the country's industrial development. There are today over 2,000,000 Hyatt lineshaft bearings in use in practically every branch of industry, in addition to millions of bearings in the transportation, agricultural, construction, mining, and industrial machinery equipment fields.

In commemoration of the anniversary, the Hyatt Roller Bearing Co., which is a division of the General Motors Corporation, has prepared a very attractive publication called "Definite Control of Quality." This publication briefly describes the different applications of Hyatt roller bearings and the methods by which they are made. The publication is profusely illustrated.

* * *

No Americans Now Being Engaged for Russia

Despite announcements to the effect that American mechanics and engineers are not being engaged for work in the Soviet Union at present, thousands of applications are still pouring into the office of the Amtorg Trading Corporation. It is stated that the reason skilled men are not being hired for the Soviet industries from the United States is that there is a temporary shortage of living quarters, which makes it impossible to accommodate any large number of foreign workers. Practically all the foreign workers and engineers now engaged in Soviet industries, it is stated, accept employment on the same conditions as corresponding Russian employes, including the payment of their salaries entirely in Soviet currency.

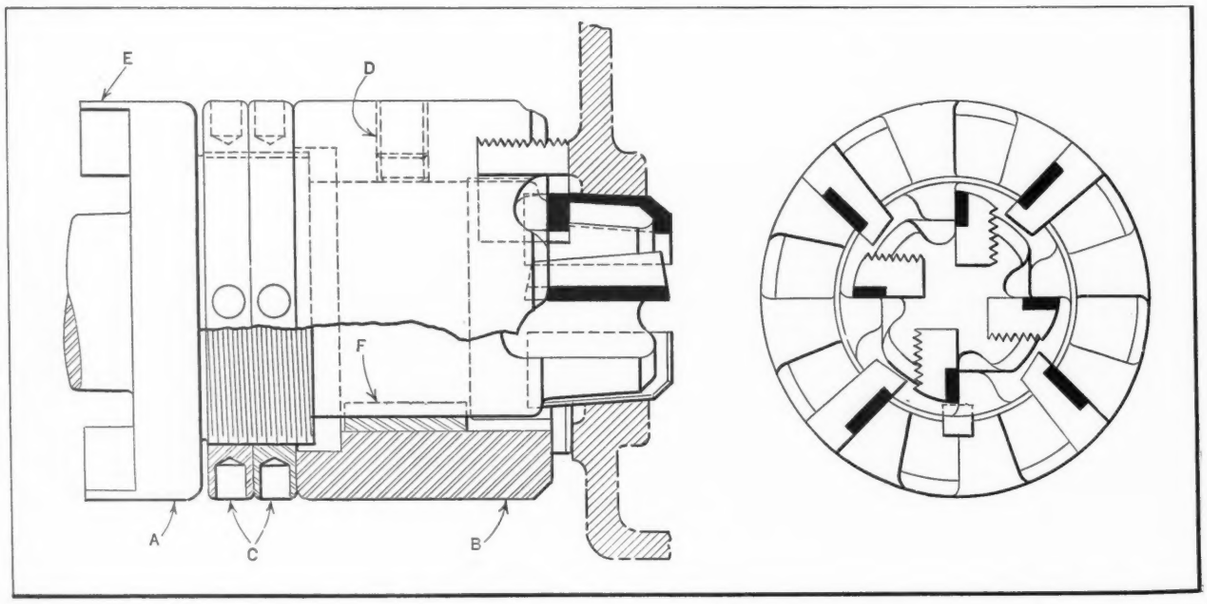


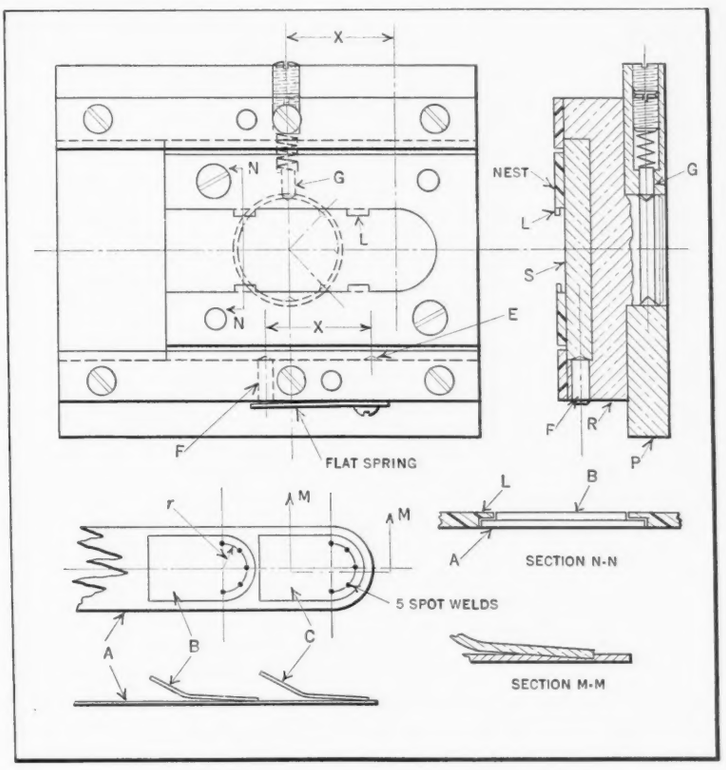
Fig. 2. Design of Bar with Tungsten-carbide Tipped Blades for Taper-boring and Facing Simultaneously

Welding Fixture for Assembling Sheet-Metal Parts

By HENRY W. BOEHLY, Richmond Hill, N. Y.

The part shown in the lower left-hand corner of the accompanying illustration consists of three sheet-metal pieces, *A*, *B*, and *C*, welded together as shown. The pieces *B* and *C* were required to be located very accurately on the piece *A*. Originally, the welding was done on a spot-welding machine by the aid of two fixtures, which required two welding operations. After changing the design of the pieces slightly, the writer found that the welding job could be done in one operation and in about one-half the time required by the old method.

The new fixture consists mainly of a baseplate *P*, which is fastened to the lower arm of the welding machine; an indexing plate *R*, which turns in the baseplate; and a sliding plate *S*, which slides in plate *R*, to which the locating nest is fastened. The three plates *P*, *R*, and *S* are made of brass.



Fixture for Welding Two Pieces to a Third Piece with Evenly Spaced Spot-welds

Location of the pieces *A*, *B*, and *C* required a special nest having small lugs *L* that overhang the piece *A*, as shown in the section *N–N*. This arrangement provided for the accurate centering of pieces *B* and *C* on piece *A*. Piece *A* had slight angular cuts, as shown in section *M–M*, for locating pieces *B* and *C*. These cuts were made with the same radius as the ends of the pieces to be located.

In loading the fixture, the piece *A* is slid in from the open side of the nest and firmly seated against the rounded end of the shallow cut in the nest. The pieces are securely welded together by making five equally spaced spot-welds. The fixture is fastened to the machine with the center of the hole in the baseplate located off center from the electrode an amount equal to the distance *r* of the spot-weld from the center.

In operation, the pieces to be welded are put in place in the sliding plate, which is held in position by the plunger *F*. This plunger is backed up by a flat spring, as shown. The first spot-weld is now made. Then the plate *R* is turned until the spring plunger *G* engages

the next indexing spot. After making the second weld, the plate *R* is again indexed and the spot-welding operation repeated. This procedure is followed until all five spot-welds are made. After the piece *B* has been welded to piece *A*, the sliding plate *S* is simply moved over until the plunger *F* engages spot *E*. The piece *C* can then be welded to piece *A* in the same manner.

Adjustable Die for Forming, Punching, and Bending

By S. A. McDONALD, Brooklyn, N. Y.

The part shown in the left-hand corner of Fig. 1 is made in different lengths from brass strip stock 0.045 inch thick. The punch and die for producing this part are also shown in Fig. 1. A plan view of the die member is shown in Fig. 2. This die is so designed that it can be quickly adjusted to make the dimension *A* of the part any desired length.

The die-shoe *B* has the die-plate *C* and the stripper *D* secured to it by screws and dowels. Die-plate *C* has a cutting edge that produces the rounded end of the part. It also serves as the die member for the piercing punch *H*. The stripper *D* contains a slot for guiding the stock, one side being extended to guide the strip and to take the side thrust while it is being cut off. Another plate *E* serves as a die for cutting the other end of the part to the notched form shown. Plate *E* also has a V-groove in it for making the right-angle bend in the part. The length *A* is controlled by the adjustable stop *F*.

A hardened tool-steel punch *G*, with its drill-rod insert *H*, does the combined cutting off, end-forming, hole-punching, and bending at one stroke of the press. A plan view of the punch is shown in the upper right-hand corner of Fig. 1. The stock, which comes in strips of the same width as the part, is fed into the slot in the stripper plate *D* by hand, so that the end projects over the die that rounds the end of the piece and punches the hole.

The first stroke of the press trims the end of the strip, and before the punch comes down on the second stroke, the end of the strip is located against the adjustable stop *F*. As the punch continues to descend, it shears off the first blank and forms the rounded end of the second piece. As the punch descends farther, it pierces the hole in the second part and bends the two ends of the first part upward when the forming portion of the punch and the groove in the shear plate *E* come together at the end of the stroke.

The press is inclined backward, so that the pieces, which are free of the stop *F*, can fall into a box at the back of the press. The scrap passes down through the shoe and bolster to a box under the press. The press is run at a speed of 100 revolutions per minute. With this die, the adjustment required for changing the length of the piece can be made in less than five minutes.

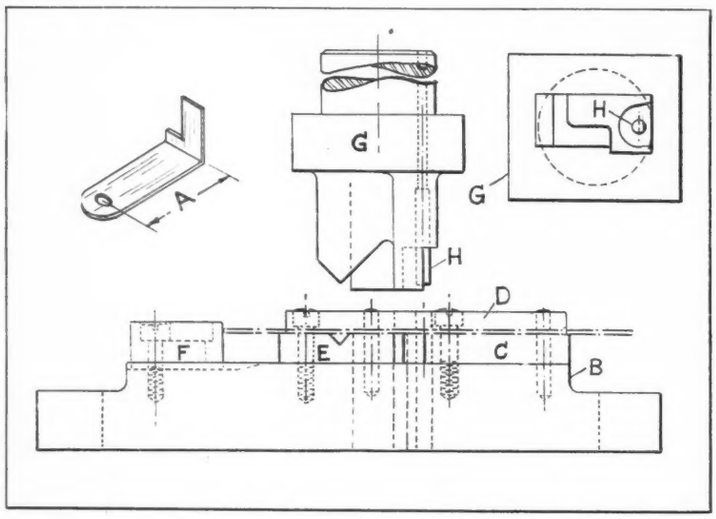


Fig. 1. Die that Produces a Piece Like the One Shown in the Upper Left-hand Corner of Illustration at Each Stroke

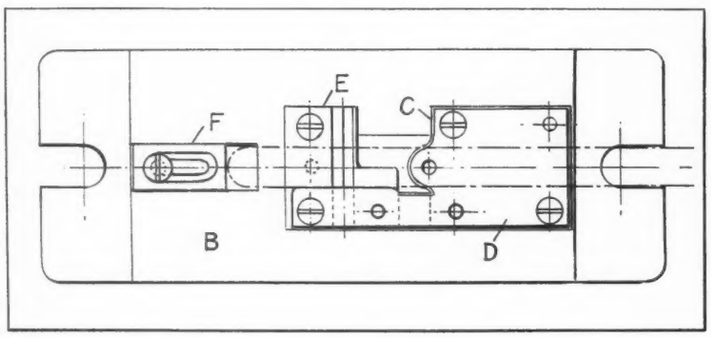


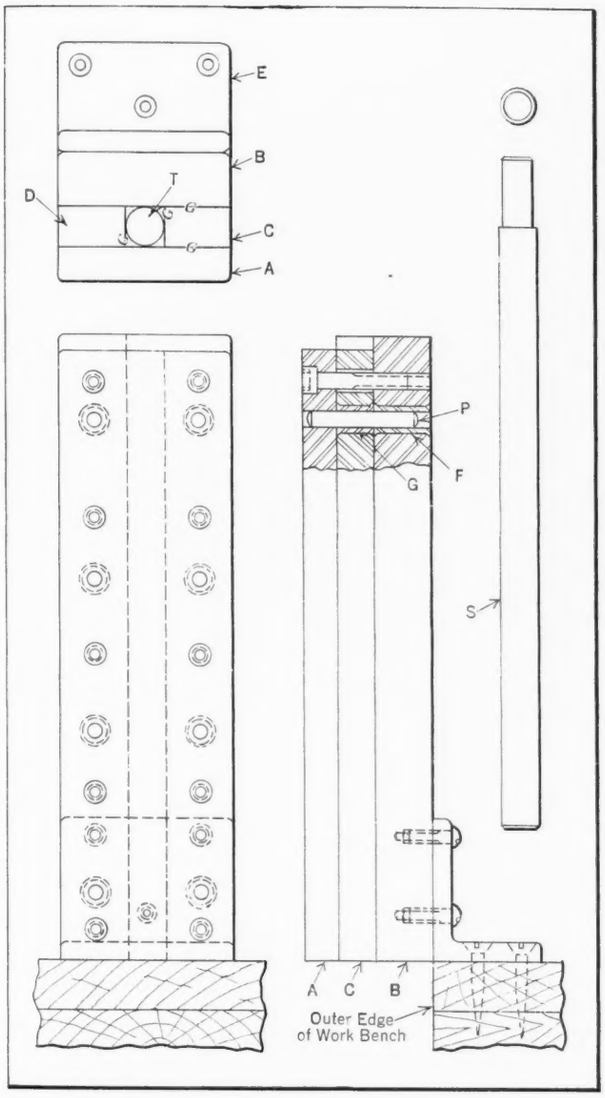
Fig. 2. Plan View of Die Shown in Fig. 1

Gage for Checking the Straightness of Shafts

By WILLIAM P. GALLAGHER, Dayton, Ohio

Shafts like the one shown at *S* in the illustration are made in large quantities from 0.622- to 0.625-inch diameter cold-drawn Bessemer steel. The limit for straightness is 0.004 inch; that is, the permissible bow or bend in the entire length of the shaft must not exceed 0.004 inch. A check-up on a thousand shafts showed that about 90 per cent were straight within this limit, just as they come from the bar stock, but as the operator had no means of testing the straightness, he simply straightened all the shafts on a bench block.

The cost of straightening was reduced about 60 per cent by using the gage shown in the illustration, which provided a means of quickly and accurately checking the straightness of the shafts before any



Gage for Checking Straightness of Shafts

work was done on them. The gage consists of two hardened and ground plates *A* and *B*, which are screwed and doweled together with two spacing blocks *C* and *D* between them.

The ground inside faces of the four parts of this assembly form a square hole 0.629 inch on each side. The holes for the eight dowel-pins *P* are drilled and reamed to a diameter of 0.250 inch in plate *A*. The corresponding dowel-pin holes in the spacing blocks *C* and *D* and plate *B* are reamed to a diameter of 7/16 inch and countersunk on both sides. After hardening, but before surface-grinding, soft steel plugs *F* and *G* are inserted in the over-size holes and riveted over on both ends. In assembling this gage, the plates and spacing blocks are clamped together and lined up with an accurately ground round steel bar *T* of the correct diameter.

While the plates are clamped in this manner, the soft plugs are drilled and reamed for the dowel-pins *P*, the location of the holes being transferred from the previously drilled and hardened plate. This method insures having the dowel holes in perfect alignment when the gage surfaces of the plates and spacing blocks are in their proper places. It also permits disassembling the gage when the surfaces have become worn through use, so that new plugs can be inserted, the gaging surfaces reground, and the parts re-aligned and assembled as before.

The shafts to be checked are entered at the top of the gage and allowed to fall by their own weight. Those that pass completely through the gage require no further attention. The few that fail to pass through are withdrawn from the gage and put aside until all the shafts in the lot have been gaged. The rejected shafts are then straightened sufficiently to permit them to pass through the gage.

The back plate *B* and the spacing block *D* are made about 1/4 inch longer than plates *A* and *C*, this extra length being allowed to extend above the front plate *A* and the spacing block *C*. The projecting ends form a V-guide which facilitates positioning the shaft between the four gaging surfaces. This kind of gage is not limited to any one size of shaft, but can be made to suit the diameter or length of any shaft that can be conveniently handled by the method described. The gage should, of course, be made as long as or longer than the shaft to be checked.

Fixture for Rolling Square Corners in Molding

By PETER F. ROSSMANN, Detroit, Mich.

Forming the square corner in the brass anglepiece indicated at *B* in Fig. 1 and at *C* in Fig. 3 is done in a rather unique way in the fixture shown

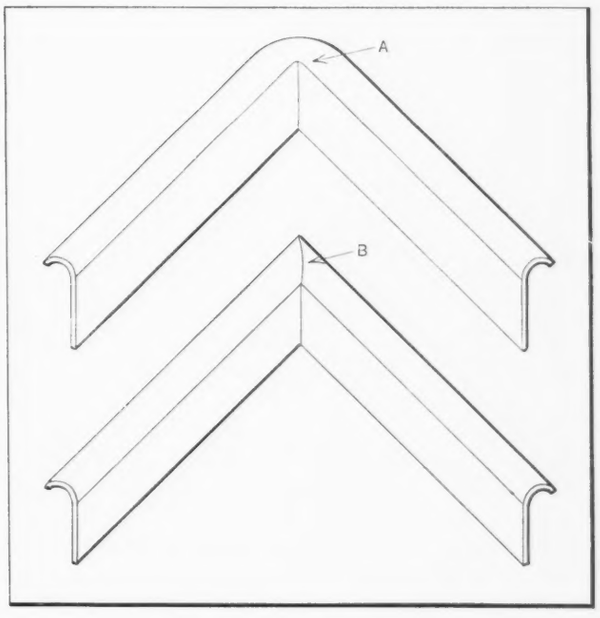


Fig. 1. View at B Shows the Extremely Sharp Corner Rolled in the Part Indicated at A

in Fig. 2. Two operations are required, however, in order to complete the corner. The first (not illustrated) consists of rough-forming in a power press, as indicated at *A*, Figs. 1 and 3. It will be noted that the corner is distorted and has a large radius. In the die used, this is the smallest radius obtainable without fracturing the metal.

In finishing the corners to the shape indicated at *C*, Fig. 3, the piece is clamped against the die *A*, Fig. 2, by the jaw *B*. Here a finished piece is shown in position. The top of the die has a raised bead that conforms with the under side of the piece. The die, with its clamping arrangement, is mounted on the slide *C*, which is operated by means of the crank-handle *D* through a train of gears and a rack. On the crank-handle shaft is secured the bending roll *E* in which is cut a depression corresponding to the rolled edge of the angle-piece.

The ratio of the gearing is such that when the crank-handle *D* of the fixture is turned, the surface movement of both the roll and the die will be the same. As a consequence, the groove in the roll will coincide exactly with the bead on the die.

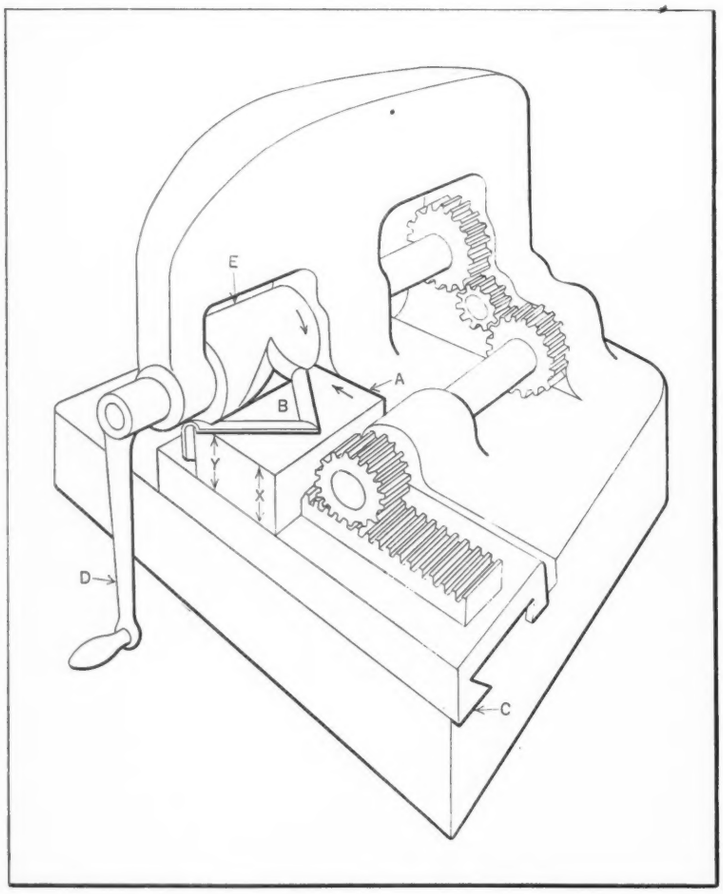


Fig. 2. Fixture for Rolling the Square Corner Indicated at B in Fig. 1 and at C in Fig. 3

The die is about 0.010 inch higher at *X* than at *Y*. Consequently, as the handle is turned in a clockwise direction, the metal is squeezed toward the bend, thus preventing fracture of the metal at this point. Continuing the rotation of the handle, the piece is forced to take the shape of the mating groove and bead on the roll and die. Only one pass of the roll is required to complete the corner. At *B*, Fig. 3, is shown the shape of one of the angle-pieces just before the roll reaches the end of the corner.

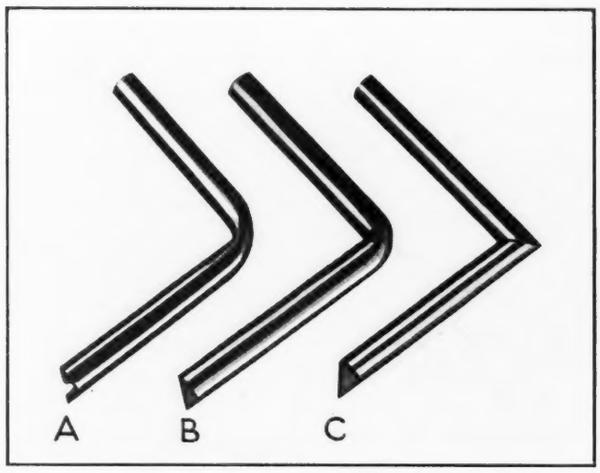


Fig. 3. Forming Stages through which Angle-piece Passes to Obtain a Square Corner

Indexing Fixture for Boring a Valve Body

By CHARLES C. TOMNEY, Chief Tool Designer
Brunswick-Kroeschell Co., New Brunswick, N. J.

In the lathe fixture here illustrated three holes are bored in a valve body in one operation by indexing the work-holder to the three positions required. The fixture is of fairly common design, but the arrangement for indexing and clamping the work-holder is unusual.

This arrangement is shown in Fig. 2. Here the spring-actuated plunger *A*, which locates the holder in its different positions, also clamps the holder rigidly with respect to the fixture proper. The indexing dial *B*, secured to one trunnion of the work-holder, has four evenly spaced V-notches with which the plunger engages. The plunger is forced into engagement with the dial by the cam *C*, which is operated by a socket wrench from the outside of the fixture. One side of the cam is flat while the remaining part is eccentric; thus when the flat portion has passed the end of the plunger the eccentric part serves to force the plunger tightly into the engaging notch in the dial, clamping the work-holder rigidly during the machining operation.

All the working parts of the indexing mechanism are enclosed to exclude dirt and chips. The same

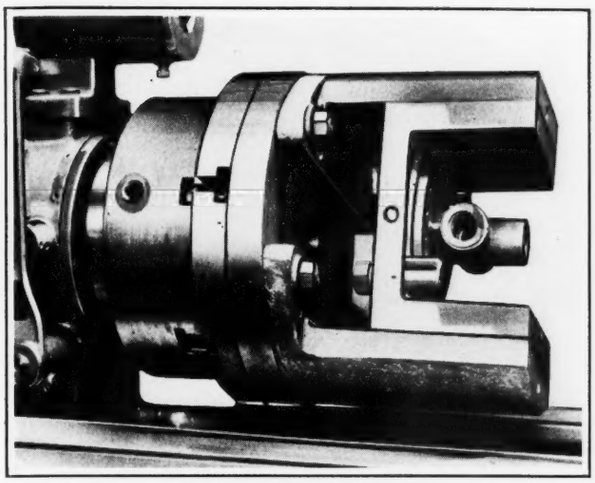


Fig. 1. Indexing Fixture for Boring Holes at Three Different Angles

socket wrench as is used for the cam is applied to the plug *D* for rotating the work-holder to its various indexing positions. None of the indexing members protrude outside of the fixture, and for that reason, this design is particularly desirable where there is a limited clearance between the fixture and the carriage ways.

Piercing and Bending Dies of Arc-Welded Construction

By H. C. TEN HORN, Nijmegen, Holland

An arc-welded structural steel die composed of the members shown in Figs. 1 and 3 (see following page) solved the problem of perforating or piercing nine properly spaced holes in 15,000 sheets. When confronted with this job, the writer realized that to use a jig for drilling all the sheets or to construct a die of the usual type for piercing the holes would be too expensive, and fortunately hit upon the idea of performing the work on a die constructed as shown in Figs. 1 and 3. This arc-welded construction is the cheapest method known to the writer for producing an accurate die for such work.

The die-holder shown in Fig. 1 was built up of the channel-iron pieces *A* and *B* which were cut to length by a power shear and joined together by arc-welding. The piercing dies *E* were located by six steel pieces *F* welded to the tops of the channels *A*. Holes were drilled through pieces *F* and tapped to receive the bolts *C*. Holes were also drilled through the channels to allow the piercings to pass through the web. A piece of wood was used occasionally by the operator to push the piercings out from under the channels in order to prevent clogging. The die was secured to the bed of the press by bolts which passed through the holes in the angle-pieces *D*, welded to channels *A*.

The punch-holder, as shown in Fig. 3, was built up of I-beams which were cut to the right length and shape on a shear and arc-welded together as shown. The punch sockets were welded to the I-beams in the correct position to have the punches register properly with the holes in the dies *E*, Fig. 1. The punch- and die-holders were planed slightly to give firm bearing surfaces on the ram and bed of the press. After completing the piercing operations on the 15,000 sheets, the die was still in good condition and ready to handle a repeat order. After this very satisfactory experience with the arc-welded die, the writer employed dies of similar construction for other jobs with equal success.

In Fig. 2 is shown another die of arc-welded construction which was employed for bending the V-channels in steel stairway sheets for factories. A cross-section of one of these sheets is shown at *A*. The vee bending punch *B* on the lower die member

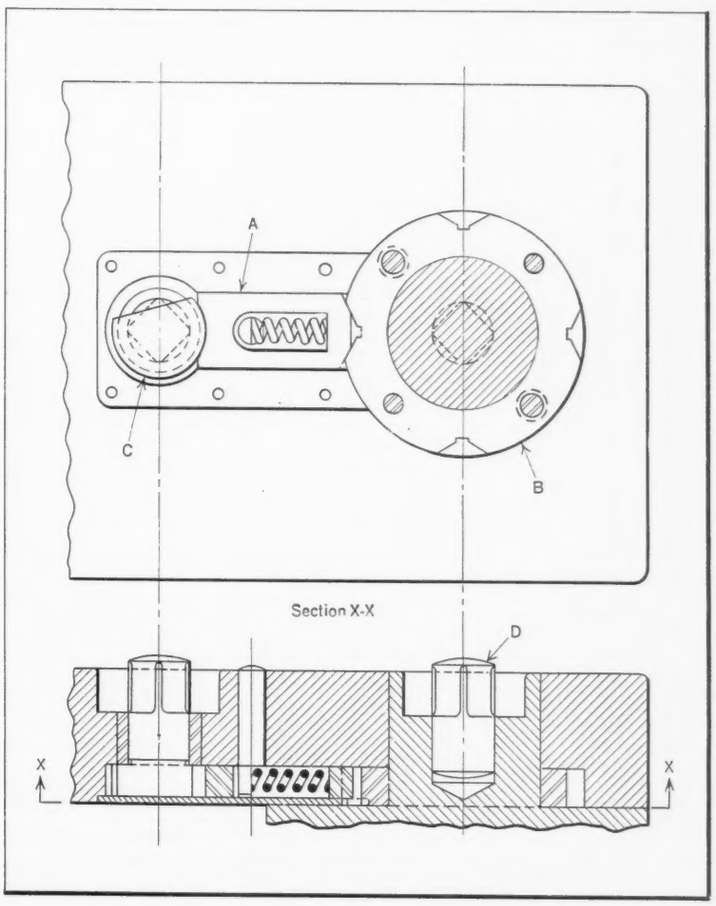


Fig. 2. Indexing Mechanism for Fixture Shown in Fig. 1

was built up with manganese welding rod on the beam *C* and then ground to shape. Two properly spaced spring steel rods *D* and *E* were welded to the upper member.

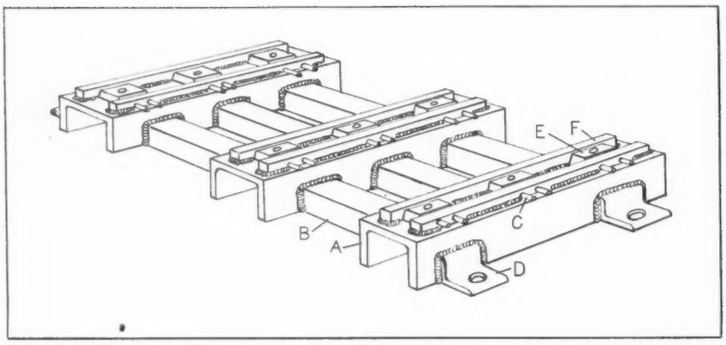


Fig. 1. Arc-welded Structural Steel Die for Piercing Sheet Steel

The ends of the groove or channel between the two rods were then filled in with welding material and ground until smooth at the ends *L*. The stop-pieces or gages *F* and *G* serve to determine the spacing of the grooves formed in the work, and the stops *H* and *K* align the sheet properly on the first stroke of the press. Webs were welded to both I-beam members, as shown, to give greater rigidity. Both members of this bending die were secured in place on the press by means of U-clamps.

* * *

A recent issue of the London *Economist* analyzes the trade between Great Britain and the Soviet Republics for the last three years. The volume of trade in 1931 amounted to approximately $70,000,000. The present low value of the pound is likely to increase Soviet purchases in England.

Improvements in Monel Metal

As a result of recent developments in the forging of Monel metal rods and shafts of large diameters at the plant of the International Nickel Co., Inc., at Huntington, W. Va., it has been found possible to further increase the range of physical properties of this metal. A uniform ultimate tensile strength of over 90,000 pounds per square inch and a yield point of over 70,000 pounds per square inch are recorded in forged bars from 3 to 6 inches in diameter. The elongation averages over 25 per cent. Such properties, for example, are obtainable in propeller shafts 6 inches in diameter and 14 feet long. A test piece cut from this forging actually had a tensile strength of 103,000 pounds per square inch.

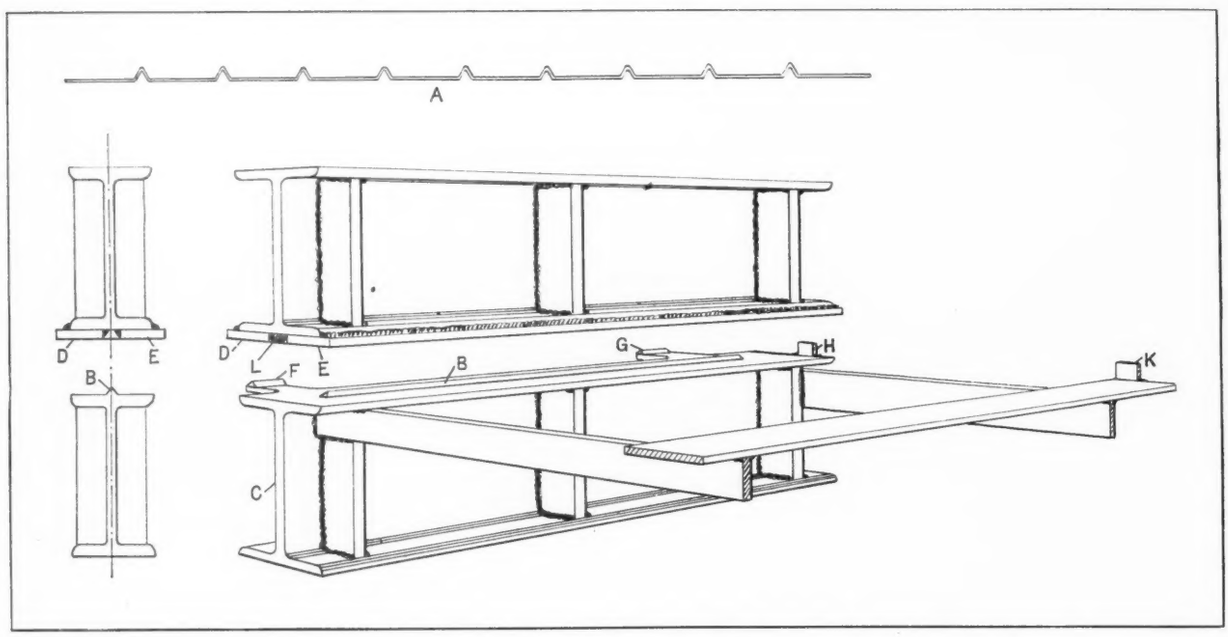


Fig. 2. Arc-welded Die for Bending Stairway Plates Shown by Cross-section A

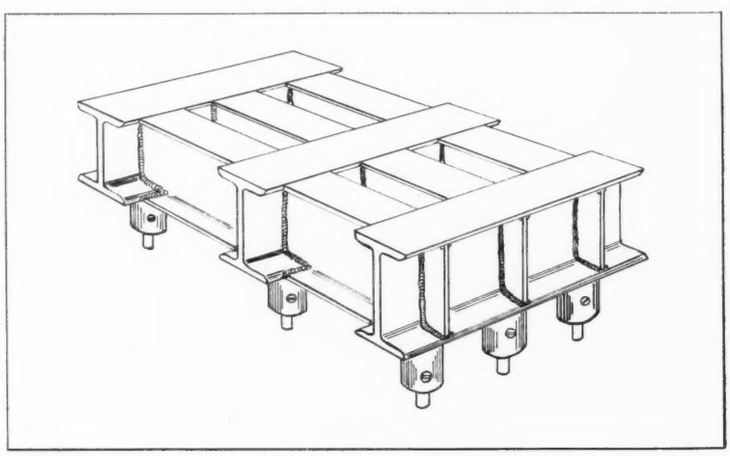


Fig. 3. Punch Member of Die Shown in Fig. 1

MACHINERY'S DATA SHEETS 227 and 228

COMPOSITION AND APPLICATION OF TOOL STEELS—1

Typical Composition	Characteristics and Applications
Super High-Speed Steel (High Cobalt Type) Carbon 0.75 Tungsten 18.50 Chromium 4.50 Vanadium 1.75 Molybdenum 1.00 Cobalt 9.00	A dense, tough, heavy-duty, high-production steel, particularly adapted for deep cuts on hard scaly material. Especially suitable for lathe, planer, shaper, cut-off, and boring tools. Higher production is made possible through greatly increased cuts and feeds, as well as longer tool life. A superior cutting material that will withstand rough usage. Equally well adapted for cutting steel, cast iron, or nonferrous materials. Used in the form of solid shank, welded-tip tools, and tool bits.
Standard High-Speed Steel Carbon 0.70 Tungsten 18.00 Chromium 4.00 Vanadium 1.00	A well balanced cutting material that has been thoroughly tried and proved on all types of work. Accepted by the trade for its uniformity of results and ease of application. Applied to all general cutting operations requiring lathe, planer, and similar tools, as well as milling cutters, drills, reamers, broaches, chasers, taps, etc. Also used for forming punches, dies, and shear blades.
Finishing Steels Type No. 1: Carbon 1.30; Tungsten 3.50; Chromium 0.50; Vanadium* 0.20 Type No. 2: Carbon 1.15; Tungsten 1.40; Chromium 0.25; Vanadium* 0.15 *Vanadium is optional.	These are special steels developed to give better results than high-carbon steel on certain cutting operations. They have a limited application in fast-finishing work and in cases where very keen edges are required on hard material.
Hot Work Steels Modified High-Speed: Carbon 0.45; Tungsten 16.00; Manganese ....; Chromium 3.50; Vanadium 0.50 Low Tungsten Type: Carbon 0.35; Tungsten 10.00; Manganese ....; Chromium 3:25; Vanadium 0.50 Chromium Type: Carbon 0.95; Tungsten ....; Manganese 0.40; Chromium 3.50; Vanadium	These three types have been developed to meet numerous hot work requirements. Their outstanding properties are strength and hardness at high temperatures. They possess considerable toughness, as well as a high resistance to thermal fatigue and cracking. These steels cannot be used for the usual cold-cutting work. They have been applied successfully to hot blanking, drawing, extrusion, hydraulic-forming, forging and swaging, and are suitable for trimming dies, bulldozing tools, nut piercers, hot punches, rotary shears, flying shears, cut-offs, die-casting dies, etc.

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MACHINERY'S Data Sheet No. 227, New Series, June, 1932

Contributed by Owen K. Parmiter
Firth-Sterling Steel Co., McKeesport, Pa.

COMPOSITION AND APPLICATION OF TOOL STEELS—2

Typical Composition	Characteristics and Applications
High-Carbon High-Chromium Steel Type No. 1: Carbon 1.50; Manganese 0.25; Chromium 12.50; Vanadium 1.00; Cobalt ....; Molybdenum 1.00; Nickel .... Type No. 2: Carbon 2.25; Manganese 0.25; Chromium 12.50; Vanadium 0.25; Cobalt ....; Molybdenum ....; Nickel Optional Type No. 3: Carbon 1.40; Manganese 0.40; Chromium 12.50; Vanadium ....; Cobalt 3.50; Molybdenum 0.80; Nickel	A steel of intense hardness and exceptional resistance to abrasion, with little tendency to warp or change dimensions in hardening. Hardens deeply and uniformly. A high-production die steel of unusual merit. Developed and recommended especially for purposes requiring maximum wear-resistance and where heavy pressure rather than sudden shock must be withstood. Used for trimming, blanking, extrusion, drawing, swaging, pressing, thread-rolling, coining, shearing, compressing, and slotting dies. It also gives excellent results in punches, rolls, plug gages, taps, burnishing gears, bushings, reamers, broaches and lathe centers.
Oil-Hardening Punch and Chisel Steel Carbon 0.50 Tungsten 2.00 Chromium 1.25 Vanadium 0.18	This steel possesses great strength and a high degree of toughness when hardened. It compares favorably with chrome-nickel and chrome-vanadium steel in this respect. For Cold Work: Chisels, punches, rivet busters, screwdrivers, pipe cutters, shear blades, battering tools, beading tools, cold sets, swages, and boilermakers' tools in general. For Hot Work: Hot heading and forming tools, die inserts, hot cutters, shear blades, and forging dies.
Non-Deforming Oil-Hardening Steel Type No. 1: Carbon 0.90; Manganese 1.25; Tungsten 0.50; Chromium 0.50; Vanadium* 0.15 Type No. 2: Carbon 0.95; Manganese 1.70; Tungsten ....; Chromium ....; Vanadium* 0.15 *Vanadium is optional.	A deep-hardening steel that can be quenched in oil with the minimum degree of distortion and dimensional change. Breakage in hardening is practically eliminated in this steel. It is adapted for master tools and gages, and for blanking, punching, trimming, forming, and threading dies. Also used for taps, reamers, broaches, hobs, thread-rolling dies, form tools, and dies of intricate shape and design.
Water-Hardening Carbon Steel Carbon 0.95–1.15 Silicon 0.15–0.25 Manganese 0.20–0.28 Chromium Under 0.05 Vanadium (optional) 0.15	In the hardened state, this steel has the advantage of a hard wear-resisting surface in combination with a tough shock-resisting core. The intensity of hardness and the depth of hardening can readily be controlled by suitable heat-treatment. Especially adapted to cold-heading work, but also successfully applied to blanking, forming and stamping dies, punches, molds, etc. An excellent water-hardening die steel for almost any purpose.

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Determining the Value of Tungsten-Carbide Milling Cutters

A Series of Experiments Conducted for the Purpose of Ascertaining the Factors Underlying the Successful Application of Tungsten Carbide to Milling—Second of Two Articles

By B. P. GRAVES, Director of Design
Brown & Sharpe Mfg. Co., Providence, R. I.

IN the first installment of this article, published in May MACHINERY, page 650, a great number of tests made on tungsten-carbide milling cutters at the plant of the Brown & Sharpe Mfg. Co. were described in detail. The present article will record the results of a few additional tests and will give the conclusions based on the tests. The concluding paragraphs will deal with the use of tungsten-carbide tools in automatic screw machines.

The series of tests to be discussed here are those conducted with 9-inch diameter cutters. Four of these tests are listed in Table 5.

Of these tests, No. 42 gives the best results, using a surface speed of 226 feet per minute and a chip per tooth of 0.0145 inch. It might be argued that the chip per tooth is too high, but at the time of writing, no test has been conducted to determine this.

Test 34 shows distinctly the result of using a surface speed greatly in excess of 235 feet per minute. Test 42 is an exact duplicate of Test 34, with the exception of the speed, which is 226 feet per minute. It will be noted that this increased the chip per tooth from 0.0117 inch to 0.0145 inch.

Test 11, on the other hand, reveals that although it is possible to increase the time life of a cutter by reducing the speed and feed, the decreased production offsets any gain in the cost of grinding. In all fairness, it should be noted that the depth of cut in Test 11 was 1/8 inch, as compared with 1/16 inch on the other tests.

The set-up for Tests 34 and 42 is shown in Fig. 3. Vise beds, instead of test blocks with uniform cross-sections, were used in Tests 27, 34, and 42. The construction of these vise beds permitted the action of the tungsten-carbide cutter to be observed under intermittent cutting conditions. At a feed of 24 3/4 inches per minute, there was no indication that the vise edges were being broken. The test block used in Test 11 gave a Brinell hardness reading very nearly the same as that obtained on the vise beds illustrated in Fig. 3. The difference in the rate of stock removed per minute when the cutter had become fully engaged in the cut was very slight.

It will be noticed that the time is given in all of the tests. This refers to the actual cutting time; that is, the number of cuts multiplied by the time, measured from the instant the cutter commences to cut until it completes the cut at the other end. Where the test blocks had different cross-sections, the cubic inches of stock removed is given. The length of cut, in inches, represents the actual length of the stock cut. Nothing is allowed to compensate for the time required to attain the full cut or to take care of the distance the cutter moves in finishing off the cut.

Recommended Speeds and Feeds for Milling

To prescribe a rate of speed and feed that would be suitable for milling all types of cast-iron jobs is, of course, impracticable. However, the tests clearly indicate that for the most efficient operation of the cutter, the range of speed should be between 200 and 235 feet per minute. The feed that will give the best results is that which will give a chip per tooth of from 0.008 to 0.013 inch.

These recommendations for speed and feed are based on what might be considered an aver-

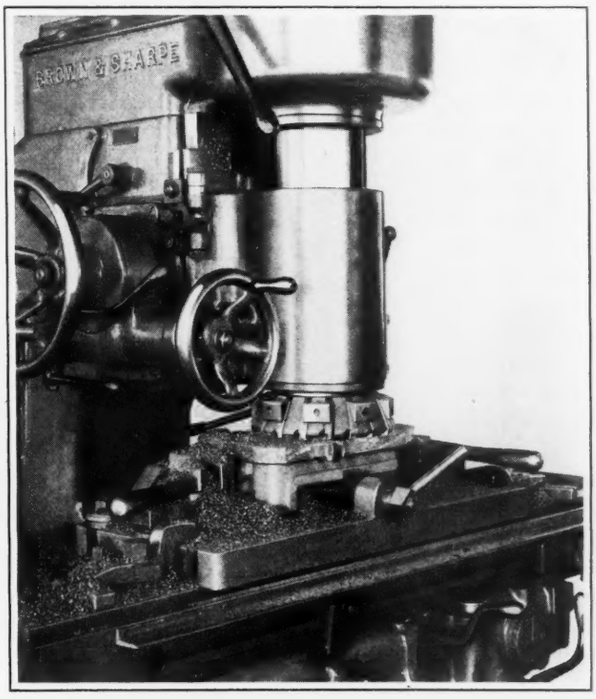


Fig. 3. Milling Cast Iron with a Speed of 226 Feet per Minute and a Feed of 24 3/4 Inches per Minute. The Depth of Cut is 1/16 Inch. The Cutter is Resharpened after 1020 Cuts (Test 42)

Table 5. Results of Tests on 9-Inch Tungsten-Carbide Tipped Face Mills

Test No.	Speed, Feet per Minute	Table Feed, Inches per Minute	Chip per Tooth, Inch	Total Cubic Inches of Cut	Depth of Cut, Inch	Actual Cutting Time, Minutes
34	276	24.750	0.0117	3160	1/16	438
27	238	23.812	0.0131	3400	1/16	511
42	226	24.750	0.0145	4670	1/16	646
11	205	14.437	0.0092	3180	1/8	648

age job. Cuts have been made successfully at feeds and speeds varying notably from the values given above. In such cases the conditions are unusual. In many instances, the piece to be machined is of such construction that it will not withstand a high feed. When this is so, a cutter should be selected that will give the proper chip per tooth at a surface cutting speed between 200 and 235 feet per minute with the feed selected. Frequently, also, the casting or work-piece is sufficiently sturdy to withstand a heavier feed than can be used with the cutter on hand.

In common practice, a lack of teeth should not be compensated for by an increase in revolutions. In several preliminary tests, surface speeds of 400 feet and higher were attempted, and the performance was remarkable. At best, however, this must be considered a stunt and short cutter life accepted as inevitable. Only in a few instances is such a practice to be considered. If a higher rate of production than can be obtained with the economical combination of speed and feed is desired in order to keep pace with a line production job, or if it is necessary to rush work for a short time, then an increase in the figures given above might be warranted. The cutter cost will increase due to decreased life, but the net saving may offset the loss sustained due to short cutter life. On a production job it is advisable to invest in more equipment rather than overtax the equipment on hand.

Power Requirements of Tungsten-Carbide Cutters

From the power readings taken in many of the tests, it is evident that tungsten-carbide cutters operating at a proper speed and feed will require more power than high-speed steel cutters operating at maximum capacity. In both cases it must be remembered that an increase in the number of teeth may require power beyond the capacity of the machine, if the chip per tooth is kept at the proper value.

This means that machines on which tungsten-carbide cutters are to be used must be very rigid and must be equipped with a somewhat higher range of speeds and feeds. Likewise, the fixtures used to hold the work in position under these heavy cuts must be more rigid. In other respects, designs that are considered good for high-speed steel milling machine operation are also applicable to tungsten-carbide usage.

A cutter that has lost its keen cutting edge will not necessarily increase the power consumption. In many tests, the final power reading did not vary more than 15 per cent from the initial reading, and in a few instances during the test, the power consumed was less than that required at the beginning. It was noted that the hardness of the test block had some effect upon the power consumed, as would be expected, but kept within a range of from 150 to 200 Brinell on cast iron, the effect was not of any great consequence.

However, from these tests it appears that for the most economical use of tungsten-carbide cutters, they should not be permitted to become so dull that it will be necessary to remove more than 0.006 to 0.008 inch of stock at one grinding.

Time Required for Grinding Cutters

The time required to grind the tungsten-carbide cutters used in these tests was, on an average, about three times that required to grind a similar high-speed steel cutter. This presents a problem that is yet to be solved. When this is done, the value of tungsten-carbide cutters will be greatly enhanced. It is quite possible that fixtures of new design will be necessary to hold these cutters while grinding, and along with this development it must be determined what grinding wheels give the best results.

It would be unreasonable to suppose that tungsten carbide which has proved its ability to remove metal at a high rate under certain conditions would give the same results in any machine. It is not possible to predict the performance of tungsten carbide on another machine by the results obtained from tests on milling cutters.

The conditions for milling steel satisfactorily

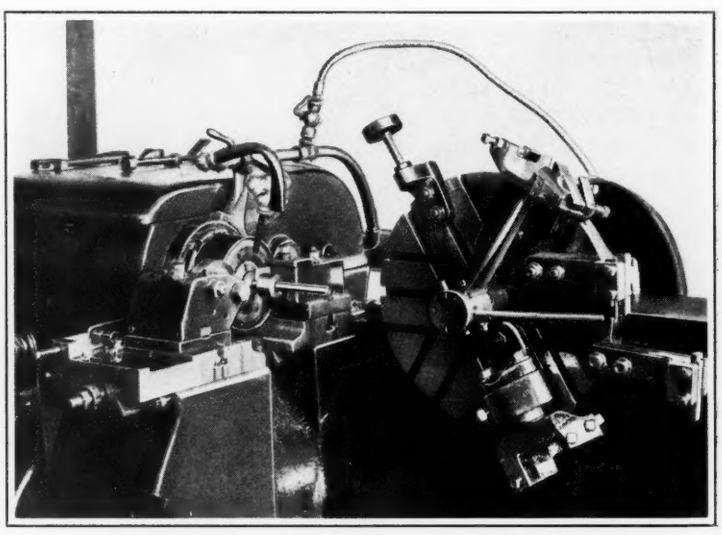


Fig. 4. Automatic Screw Machine "Balance" Toolholder Equipped with Tungsten-carbide Blades

with tungsten-carbide cutters have not yet been determined. Tests now being conducted are expected to provide much information on this phase of tungsten-carbide milling practice.

Many other set-ups could be outlined to show the performance of tungsten carbide. At the completion of tests now being conducted on steel milling, further tests will be conducted on milling cast iron, and it is hoped that the data thus obtained will prove as interesting as those here outlined, and will serve to define even more closely the correct values for speeds and feeds to use in milling cast iron with tungsten carbide.

The Use of Tungsten-Carbide Tools in Automatic Screw Machines

The action of an automatic screw machine is very different from that of a lathe or a milling machine. A tool that is securely fastened to a lathe toolpost will not be acted upon in the same manner as a blade fixed in a rotary milling cutter, nor as a tool held in the conventional way in an automatic screw machine.

However, the past record of a cutting alloy is valuable in predicting probable performance. Only by experimenting can the proper speed and feed of a cutter be determined for use with a particular machine, fixture, or material.

An example of the application of tungsten carbide to a screw machine is illustrated in Fig. 4. The piece is a machine part made from cold-rolled bar stock (S A E 1015), and is being machined on a Brown & Sharpe No. 6 automatic screw machine. This set-up was made for the purpose of testing both the machine and the tool blades. The stock is reduced 1 inch in diameter—from 1 9/16 inches to 9/16 inch— with the tools held in a "balance" turning tool-holder. The cut is 4 1/16 inches in length.

This turning operation is performed at a surface speed of 300 feet per minute at the outside diameter of the bar stock, and with a feed of 0.0055 inch per revolution of the spindle.

The tool blades showed no appreciable wear after machining 900 pieces. Additional short tests conducted with the same surface speed and feeds ranging to 0.015 inch per revolution of the spindle were used to determine the action on the spindle driving mechanism.

Tungsten carbide has proved very successful in turning bronze. On bushings with a finished outside diameter of 2 9/16 inches and an over-all length of 4 27/32 inches, a saving of 37.5 per cent has been effected. The surface speed used is 540 revolutions per minute, and the feed, 0.008 inch per revolution. In all turning of bronze, a surface speed much higher than that recommended for milling cast iron is being used.

However, the example quoted here is not necessarily the correct value for all bronze castings. Another bronze bushing 2 1/2 inches in diameter and 3 7/16 inches long is being turned at 410 feet per minute, with 0.008 inch feed per revolution. This effects a saving of 20 per cent over the previous method. In each case the percentages are the savings due to the use of tungsten-carbide tools and not to any attendant change in the holding devices, machines, etc.

Performance of Molybdenum Alloy-Steel Hacksaw Blades

The development of numerous alloy steels that could not be efficiently cut with the older types of hacksaw blades has prompted many improvements both in the materials from which hacksaws are made and in methods of manufacture. The molybdenum alloy-steel hacksaw blade developed by the Victor Saw Works, Inc., Middletown, N. Y., and associated companies, after a long period of experimentation, represents one of the latest of these improvements.

The results of some carefully conducted tests with these blades show the possibilities of modern hacksaw performance. These tests were performed on a Peerless machine at a speed of 100 strokes per minute and a feed pressure of 110 pounds, using Cutrite cooling solution. The steel cut was a 2 5/8-inch square bar of chromium ball steel, heat-treated. The saws were tested until worn out. An operating cost of 50 cents per hour is assumed.

The saws used in the tests were of molybdenum alloy steel, 12 by 1 by 0.065 inch—10-point type.

In the first test, 87 cuts were made with an average of 846 strokes per cut. The first cut was 578 strokes; the last, 1170. The total time required for the test was 12.26 hours. The cost per cut was $0.07.

In another test, 57 cuts were made with an average of 1111 strokes per cut. The first cut was 732 strokes; the last, 2070. The total time required for the test was 7.54 hours. The cost per cut was $0.066.

A comparison of these figures with the results of past performance will readily indicate the savings that can be effected with recently developed hacksaw blades.

A few examples of cutting results in actual practice may also be of interest. In a large street railway shop, 90-pound rails are cut on Peerless machines at 120 strokes per minute, with 120 pounds feed pressure, kerosene being used as the cutting solution. During twelve cuts, molybdenum alloy hacksaw blades averaged 9 minutes 10 seconds per cut, and showed no appreciable wear.

In another case, 3/4-inch hexagon tool steel was cut off at 100 strokes per minute in 15 seconds for the first cut and 20 seconds for the second, no cutting solution being used.

Polishing Stainless Steel and Iron*

Directions for Obtaining a High Quality Finish on the New Stainless Materials that Until Recently were Difficult to Polish

TO produce a lasting luster on any finished piece of stainless steel or iron, whether it be made from sheet stock or a casting, the finished surface must be free from minute foreign particles, particularly finely divided iron, and all slag spots, scratches, pit holes, or tiny imperfections must be removed.

The possibility of impurities being left on the surface may be minimized by using, in all polishing and buffing operations, manufactured aluminous abrasive that is substantially free from iron. Proper selection and sequence of grain sizes, the crossing of scratches in each succeeding polishing operation, and additional operations when crossing of scratches is impossible will minimize the probability of scratches or other imperfections being left on the finished surface.

Generally speaking, the principal difference in grinding or polishing stainless steel or iron and other steels is that stainless metals are a little tougher and a little more stringy. They show a tendency to drag; and because of this action, the wheel life is shorter. Otherwise, the polishing of stainless steel is much the same as the polishing of any steel, although the operators must be more careful with stainless steel than with carbon steel. Care must be exercised to prevent excessive heating; wheel speeds and pressure must be controlled; the proper amount and type of lubricants must be used; and care should be employed in the selection of buffs and abrasive grain sizes.

In polishing, wheel surface speeds should range between 6500 and 7500 feet per minute. In buffing, the speed should be between 10,000 and 12,000 feet per minute. During all operations it is very important that the wheel be in balance.

Tallow or some other lubricant should be used to prevent overheating and discoloration on all operations, except the first and the final coloring. In cutting-down operations, the operator should avoid forcing the wheel, as this often causes discoloration, which is difficult to remove in later operations.

How Scratches Can be Prevented

In the roughing operations, as fine a grain size as possible should be used, in order to prevent deep scratches which may require additional operations to remove. Finer sizes may be used for the first operations on sheet stock than on castings.

Having selected the proper size and sequence of grain, the crossing of scratches will materially aid in attaining the desired finish. When succeeding scratches follow in the same direction, there is a tendency for the abrasive to cut deeper, necessitating further operations and waste of material to remove these cuts. Crossing of the marks also enables the operator to determine whether or not the scratches of the previous operation have been removed. In some cases, where automatic machinery prevents the crossing of scratches, additional operations will be necessary to obtain an equivalent finish.

Types of Machines in Use for Polishing Stainless Sheets

Several types of machines are used in polishing stainless steel sheets. On one machine, an endless belt made of canvas 50 inches wide and approximately 20 feet long, coated with abrasive, is used. The belt is driven by two pulleys, one of wood and the other of sewed buffs, to give a cushion for the belt and take care of any irregularities in the sheet. This cushion pulley is essential, as a hard pulley would cause the belt to burn the sheet.

A roll 50 inches wide, made from sections of sewed buffs 20 inches in diameter pressed on a steel shaft 6 inches in diameter and coated with abrasive, is used in another type of machine. Both of these machines operate in the same manner as a planer; that is, the sheet is held on a table which moves back and forth under the belt or roll.

Another type of machine now being developed can operate either a belt or a roll and is so constructed that several units can be attached together, the sheets passing under each roll, making it possible to rough a sheet in one pass through the machine. It has a clamping device which connects the ends of the sheets so that the machine is continuous in operation. The belts used on this machine are 7 feet long.

How to Coat Belts and Rolls

Two methods are used in coating belts and rolls. When fine grain sizes are used, the general practice is to thin the glue to the proper consistency for the size of the abrasive to be used, then add the abrasive until the mixture is of the right consistency to spread. It is important to stir the mixture thoroughly before application. The abrasive, being so much denser than the glue solution, settles to the bottom very rapidly, and unless held in suspension by stirring, it will be almost impossible to get a uniform structure on the coated belt. Two coats of abrasive are generally used on the belts. In coating the rolls, as many coats are used as are needed to build up a head approximately 1/4 inch thick.

When coarse grain is used, the paste process is impractical because of the difficulty of spreading

*Abstract of an article in *Grits and Grinds*, by W. C. Breiting, E. F. Brown, E. F. Gleason, and R. S. Schwaegerle, of the Norton Co., Worcester, Mass. The recommendations of these Norton grain demonstrators are based upon actual experience in factories throughout industry.

the mixture of glue solution and grain. The size of grain that can be used in paste form depends upon the experience and skill of the set-up man and the requirements in each instance. In some cases, a paddle rather than a brush is used for spreading; but even this procedure may result in an extremely hard coating, which tends to burn the metal.

The more practical method of coating belts with coarse-size grain is to apply the glue solution to small portions of the belt or roll at a time, and spread the abrasive on the glue by sifting. The grains are readily bonded by the glue and a more uniform head results.

Truing up the Rolls

After being coated, five or six days are allowed for the rolls to dry. Out-of-roundness is then corrected by turning the rolls in an engine lathe, using a Crystolon abrasive brick in the toolpost. The use of oil on the brick will prevent it from glazing the surface of the roll. In turning a roll a slow speed should be used at first, but it should be finally trued at running speed.

Determining the Size of the Abrasive in Polishing

The grade of the rolled finish, which varies in different mills, will determine the size of abrasive to be used on the first or roughing operation. Where Alundum abrasive is used, a range of from No. 60 to 80 is giving very satisfactory results. For the second operation, which depends upon whether or not No. 60 is used to rough-grind, the roughing marks can be removed by using from No. 90 to 120; and for the final finish, from No. 180 to 320, depending upon the type of finish required.

The size of the grain used on sheet stock after it comes from the mills also depends upon the condition of the sheet, as, for instance, whether or not there are die marks, and the depth of these marks. The use of No. 120 or No. 140 (G.M.S.) grain size to remove the die marks is recommended. Then No. 170 (G.M.S.) or 200 (G.M.S.) should be used to remove the scratches. These abrasives are usually coarse enough to remove any marks that may be found in the stock and prepare it for the following operation, on which grain sizes No. 280 or 1F should be used.

This operation should be followed by a tampico brush for certain finishes, using a fine abrasive paste as the cutting agent. The surface speed of the tampico brush should be approximately 7000 feet per minute. It is possible to omit the tampico brush on very small parts, and use a quilted sheepskin wheel instead of a rag wheel on the operation when No. 280 or 1F abrasive is used. The part is then ready for the buffing wheel.

As in the polishing of other metals, there is no single set of grain sizes or materials that can be specified for each step in the polishing and buffing of this material. Varying conditions in each instance call for slightly different recommendations.

Polishing Stainless Metal Castings

Differences in the structure of stainless metal castings and sheet stock necessitate a somewhat different procedure. Castings have an outside shell which is very difficult to penetrate, and it is necessary to use a much coarser grain for the roughing operation than on sheet stock. It is often necessary to use a No. 36 grain to cut through this shell and remove it. On forgings, No. 60 grit is generally coarse enough to cut through the shell.

A No. 100 or 120 grain will remove the scratches made on the castings during the roughing operation. The following operations are the same as for polishing sheet stock. No. 120 grit is followed by No. 180 or 220, and the latter by 1F or 2F. On certain types of castings, it is not necessary to use such fine abrasives for the final polishing operation before buffing, as these castings cut more easily than sheet stock, and the buffing wheel will remove the scratches made by the polishing wheel.

The first and second set-up wheels should be used dry, but an abundance of grease or tallow should be used on the other operations. Several types of wheels are employed. On table cutlery, a compressed wheel is usually selected. A sewed buff or rag wheel is also employed on the first two operations, and a quilted sheepskin or felt wheel, depending on the shape of the piece being polished, will give the best results on the last operation.

Buffing the Metal After Polishing

Buffing is the final step in producing a high mirror finish on stainless steel. The buff should be run at a surface speed of 10,000 to 12,000 revolutions per minute. The buff should consist of a high-count sheeting, such as 88/88 or 84/92, spiral sew of 1/4 or 3/8 inch. A buff of low count should not be used, as it is advisable not to cut too much on stainless steel.

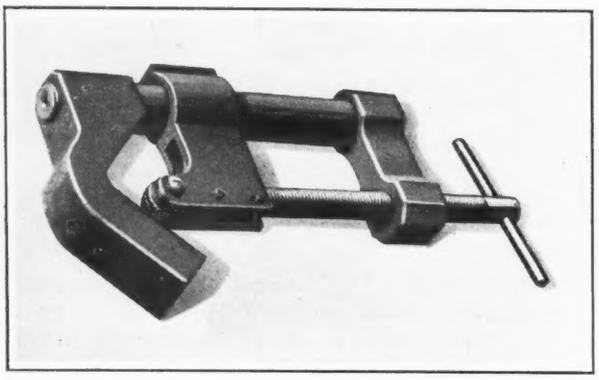
The cost of buffing stainless steel is still out of proportion with that of polishing, but there has been a decided reduction, compared to the first efforts in polishing and buffing this metal. This reduction has been due, to some extent, to improvements in buffing compounds, but principally to the fact that more time and effort are spent in polishing the metal in preparation for buffing.

The amount of grease used in buffing compounds varies according to the finish required and the condition of the piece when it reaches the buffing wheel. When it is necessary to cut out fine scratches, enough bond should be used to hold the compound on the wheel so that the operator will not try to force the cutting action and burn the metal. Too much grease will tend to leave a cloudy finish; when a high luster is desired, less grease should be used.

Several fine commercial buffing compounds are now available, though in all cases where materials are being selected, it is good practice to make certain that they are substantially free from iron or other corrosive materials that might be deposited on the surface during buffing.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Tool that can be Used for Knurling or Lettering Slender Parts

Hand Knurling or Lettering Tool

Round slender parts of various diameters can be knurled or lettered rapidly with the hand tool shown in the illustration. It consists chiefly of a V-block work-rest having an extension upon which is mounted a slide. This slide serves as a carrier for the marking disk, and to insure correct alignment of the disk with the center of the work, the extension is provided with a key that engages a keyway cut in the slide.

The work is held either in a bench vise or by some suitable clamp, and the tool is adjusted so that the disk is over the portion of the work to be marked. By tightening the screw until the disk is forced against the work and then swinging the tool about the work, the required markings are produced. When narrow work is to be knurled, it is advisable to form a channel in the V-block so that the knurled portion of the work will not rub on the V-block.

Knox, Ind. A. E. GRANVILLE

Scotch Tape for Blocking Out Dimensions on Blueprints

The writer has found Scotch tape, as referred to on page 446 in February MACHINERY, to be very valuable in blocking out dimensions, part numbers, notes, etc., on blueprints. The tape is cut to the desired shape and attached to the reverse side of the tracing over the dimension to be blocked out. By attaching the tape to the reverse side, the figures or letters will not be removed.

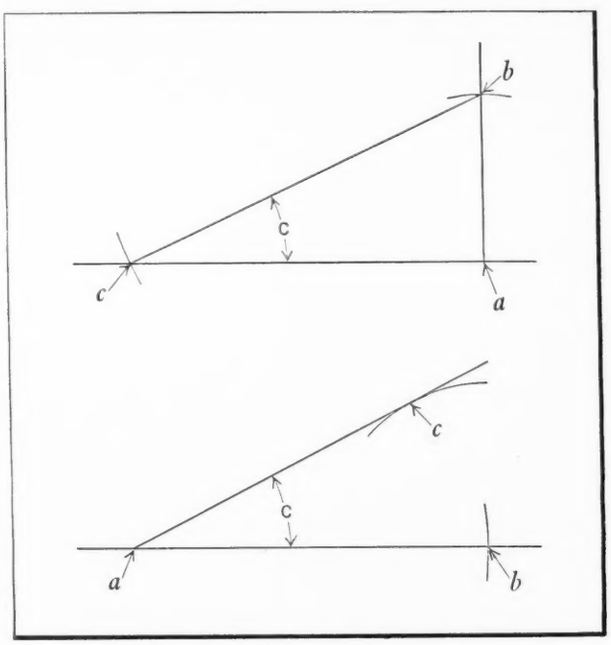
In making special equipment, a good deal of drafting was avoided by blocking out certain dimensions on standard tracings in the manner described. Two blueprints were made, one for the shop and one as a record for the engineering department. The proper dimensions were then filled in on the blocked out areas of both prints. In one corner of each print a note was made of the number of the tracing from which the prints were made.

Rockford, Ill. WALTER E. GUNNERSON

The Use of Trigonometric Functions for Laying Out Angles

Angles can be laid out accurately on drawings by constructing right-angle triangles of large scale, using a table of trigonometric functions, a compass, and a scale, as described on page 47 of MACHINERY'S book "The Use of Handbook Tables and Formulas." With this method, angle C in the upper view of the accompanying illustration is laid out to equal 27 degrees 29 minutes as follows: Erect a perpendicular on the horizontal line at a; then, using 10 as a scale, lay off $ab = 10 \times \sin 27$ degrees 29 minutes $= 4.6149$ inches. Next, with b as a center, and with a radius of 10 inches, strike the arc at c and draw cb, thus obtaining the required angle C.

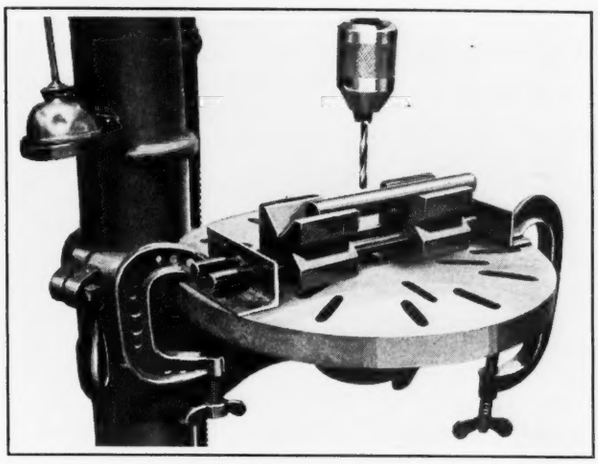
In laying out large templets and die work, it is generally necessary to locate the angle at a definite point, and for this work, the writer has found the following method more convenient: Referring to the lower view of the illustration, lay off b 10 inches



Methods of Laying out Angles by the Use of Trigonometric Functions

from a, and with b as a center and a radius = 10 × sin 27 degrees 29 minutes = 4.6149 inches, scribe the arc at c. Then, from the point a draw a line tangent to the arc c, producing the required angle C.

Springfield, Mass. H. T. LABROAD



V-Blocks with Guide Rods and Clamping Pieces

An Improvement in V-Blocks

The accompanying illustration shows an improvement we made recently in the V-blocks used in our shop for miscellaneous drilling of cotter-pin holes and other cross-drilling in round stock. The V-blocks, as the illustration shows, are mounted in pairs on parallel guide rods on which they are free to slide as desired. The round guide rods are also fitted with the two angle-iron clamping pieces shown, which are so made that the V-blocks may be moved along the guide rods even though the clamping pieces are clamped to the drill press table as shown. Thus the V-blocks can be accurately located with reference to the drill point, the block assembly then clamped to the drill press table, and the V-blocks separated sufficiently to clear the drill point. For drilling long stock, the blocks may be separated as far as the clamping pieces will permit without changing the line-up of the drill point and the V-blocks.

Spring Valley, Minn. EDWIN KILBURN

Use of Stapling Machine for Tacking Down Drawings

One method used in some drafting-rooms for securing paper to drawing-boards, but not generally known, is to employ ordinary wire staples for this purpose instead of thumb-tacks. These staples are of the U-type ordinarily used for fastening several sheets of paper together.

A hand stapling machine can be used by removing the base. The upper member can then be set flat over the paper that is to be fastened to the drawing-board. A smart tap on the operating knob of the machine will drive a staple through the paper and into the board. These staples are made of flat wire about 0.020 inch thick, so that the T-square, triangles, etc., slide over them easily.

The cost of enough staples for fastening twenty-five drawings to the board is about two cents. A small screwdriver, ground to a chisel edge and bent like a claw, is a simple and effective tool for removing the staples from the board.

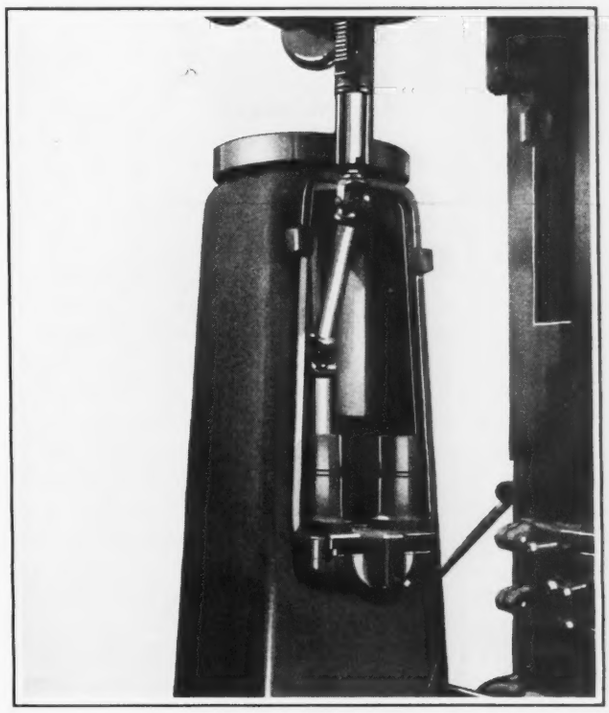
Cleveland, Ohio EDWARD HELLER

Drill-Holder for Drilling in Inaccessible Places

Drilling the holes for bearing cap bolts in a vertical steam engine frame presented a rather difficult problem because of a flange at the top of the frame which was directly in line with the holes. If drilled in the usual way, the drill would have to pass through the flange. This was avoided, however, by using an extension as shown in the illustration. The extension consists of two universal joints connected by a shaft of the required length, and is provided with a tapered shank to fit the drilling machine spindle and a socket to receive the drill.

As indicated, the machine spindle is offset enough to allow the shaft and spindle to clear the flange. To eliminate strain on the drill due to the side thrust resulting from the angular position of the shaft, the jig is equipped with extra long bushings. Both drill socket and drill are a slip fit in these bushings.

New Brunswick, N. J. CHARLES C. TOMNEY



Drill-holder Equipped with Universal Joints for Drilling around Obstructions

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

B. M.—The success achieved in chromium-plating molds for Bakelite parts leads the writer to believe that the same treatment might be employed advantageously for the molds of automatic machines used in the production of glass bottles. The writer would like to know if chromium-plating has been applied to such molds and, if so, what results were obtained. Also, what would be the proper procedure in applying the plating to molds made from cast iron?

A.—Information on this subject from two different sources indicates that chromium-plating is being successfully used for this class of molds. One correspondent states that the chromium-plating of glass bottle molds is entirely practicable and has already been adopted by some manufacturers. At temperatures above 1832 degrees F., the chromium gradually diffuses into the iron, and at temperatures up to 1841 degrees F., the life of the plating is practically 500 hours, while at 2372 degrees F., the dies are only good for about three days' use.

Two great difficulties encountered in applying chromium-plating arise from the carbon content of the iron and the projections and depressions of the mold. With iron containing less than 1 per cent carbon, plating offers no difficulty, but when it contains more than 1 per cent, it is difficult to obtain a continuous coating of the plating metal.

When the mold has projections and depressions, it is practically impossible to obtain a continuous deposit of the same thickness over the entire molding surface. These difficulties, however, can be obviated by first nickel-plating the mold and then depositing the chromium plate on top of the nickel. Chromium can be deposited successfully on the nickel, and since the coefficient of expansion of nickel is between that of iron and chromium, freedom from expansion troubles on heating is insured.

This method is satisfactory where chromium-plating would otherwise be unreliable, owing to the carbon content of the iron or to the presence of projections and depressions on the mold. The electrolyte for the plating bath should contain from 25 to 50 per cent chromic acid, with smaller amounts of, say, chromic oxide. A small addition of a metal salt, such as copper sulphate, is sometimes advisable.

A voltage of from 3 to 10 should be sufficient, the temperature of the solution being maintained at 68 degrees F. for a dull deposit and at 95 degrees F. for bright deposits. The density should be regulated to suit the condition of the part to be plated, and the time of exposure in the bath should be just sufficient to give a plating of the required thickness. If the plating is too thick, there is danger of peeling. Although steel alloys are available that will withstand the high temperatures required for glass molding, they are exceedingly difficult to machine or finish by hand, and for this reason, the writer believes that the best results would probably be obtained by making the molds from ordinary iron and applying chromium-plating to the molding surfaces.

From another source of information, it is understood that the chromium-plating of molds for automatic glass bottle machines is common practice in Great Britain. Molds of this kind are, of course, subject to heat and wear, and it is the practice to deposit chromium directly on the cast iron or steel of the mold. The commonly used intermediate coatings of copper, nickel, or other metals are not recommended for this class of work.

To chromium-plate cast-iron or steel molds of automatic glass bottle molding machines requires careful handling, and the finish of an electro deposit is as important as the plating itself. The three main factors involved in applying the plating are temperature, current density, and control of the sulphate content of the bath. Chromium solutions have poor throwing power, and it is necessary sometimes to improve the throwing power by changing the composition of the bath or adapting the shape of the anode to that of the work.

The chromium-plating may be applied either as a matt or a bright finish, but it is found in practice that the matt finish is not suitable for the glass bottle molds, as the ordinary method of polishing chromium-plated surfaces cannot be readily applied to the internal surfaces.

A typical chromium-plating solution that requires no other substances for satisfactory results is composed of chromic acid (CrO_3), 43 ounces; sulphuric acid, 0.4 ounces; and water, 1 gallon. This solution should be used at a temperature of 115 degrees F. A 4- to 5-volt current of from 1 to 2 amperes per square inch of surface to be plated is required. Lead anodes are used in this case. Thermostatic control of the temperature is desirable, although a fluctuation of 1 or 2 degrees is not harmful. The surface of the metal to be chromium-plated must be chemically clean.

Liability for Failure to Deliver Material on Time

R. Y.—A machine shop contracted to construct and make delivery of certain machinery and boilers within a given date, and for default, to pay $50 per day in damages for each day of delay beyond

the contract date of delivery. The machine shop, in turn, contracted with a steel mill for the necessary material on condition that deliveries be made within certain dates. Also, at this time, the steel mill was informed of the use to which this material was to be put, and the fact that a delay in this work beyond a certain date would render the machine shop liable for the damages. The steel mill failed to make deliveries according to its contract, and as a direct result the machine shop was delayed in completing its contract twenty days. The machine shop was then held liable under its contract for $1000. Can the machine shop recover this from the steel mill?

Answered by Leslie Childs, Attorney at Law
Indianapolis, Ind.

The general rule appears to be, though there are some exceptions, that when one enters into a collateral contract to supply materials that are incident to the performance of another contract, he will be held liable for such damages (by a breach of his contract) as were within the contemplation of the parties when the contract was signed. In view of this, the machine shop can probably recover its loss from the steel mill. (181 Fed. 38)

Welding High-Speed Steel to Mild Steel

B. L.—I would like to obtain some information on welding high-speed steel to mild steel.

Answered by W. T. Ober, Works Manager
Thomson-Gibb Electric Welding Co., Lynn, Mass.

The welding of high-speed steel is not a very recent development. It has been practiced successfully for quite a number of years, particularly by manufacturers of drills, reamers, and other cutting tools. Most high-speed steel welding is not performed between two pieces of high-speed steel, but rather between a piece of high-speed and a piece of low-carbon steel. Fundamentally, there is little difference in the method employed for welding high-speed steel to a mild steel and that employed for welding two pieces of ordinary mild steel. The same equipment is used in both cases, the principal difference being in the treatment of the welded article.

Any weld made between either two pieces of high-carbon steel or one piece of low-carbon and one piece of high-carbon steel, where the carbon content of the weld is sufficient to cause brittleness if the weld is allowed to cool in the air, must be heat-treated after completing the weld. In the case of high-speed steel, it is very essential that the welded piece be removed from the welding machine and immediately placed in a furnace or some other heating device, so as to thoroughly anneal the material adjacent to the weld line. Some means of assuring slow cooling must also be employed.

Rarely does a weld between a piece of high-speed steel and a piece of mild steel fracture in the weld line. The fracture generally occurs in the high-speed steel portion just adjacent to the weld line, or where the line of demarcation between the high-temperature and the colder material occurs.

In welding drills, where a carbon-steel shank is welded to a high-speed steel cutting bit, the best results are obtained by projecting the carbon steel a somewhat greater distance in the work-holding and current-feeding jaws than the high-speed steel piece. The high-speed steel requires more heat than the carbon steel to reach the same degree of plasticity, and as high-speed steel has a higher electrical resistance than carbon steel, this difference in the amount each projects beyond its holding jaws helps to equalize the plasticity developed in both high-speed and carbon steel at the point of weld.

It is necessary that both the high-speed steel and the carbon steel have the same degree of plasticity when the final "push-up" or welding pressure is applied. Whether or not this was the case can easily be determined by looking at the burr or upset at the weld line. If the upset on each piece on both sides of the actual weld line is quite uniform, it is an indication that the proper degree of plasticity was obtained in both pieces. If, however, the high-speed steel piece seems to have telescoped slightly into the carbon-steel piece, then the high-speed steel piece had not reached the proper state of plasticity when the welding pressure was applied. On the other hand, if the carbon steel seems to have telescoped into the high-speed steel piece, then the carbon steel had not reached the proper state of plasticity.

* * *

Wear of Metals Due to Abrasion

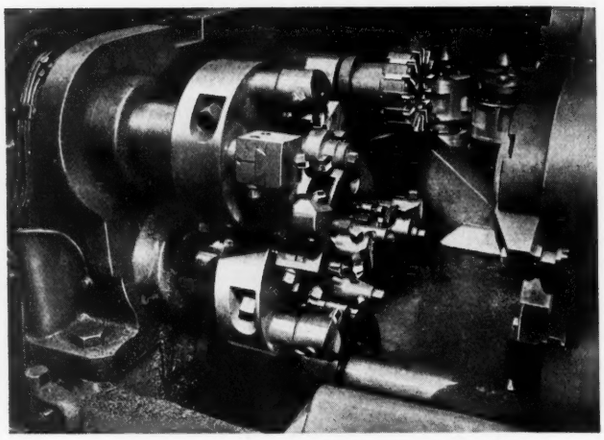
A comprehensive study has been made by the Link-Belt Co., Chicago, Ill., of the relative wear of metals due to abrasion. The results of this study were presented in a paper read by Charles R. Weiss, chief engineer of the Ewart Works, Link-Belt Co., Indianapolis, Ind., at the Management, Materials, and Maintenance Congress of the American Society of Mechanical Engineers at Detroit, Mich., May 4 and 5. In this paper are illustrated the comparative wear values of different types of S A E steels, stainless steels, cast irons, and bronzes. A type of steel containing from 0.08 to 0.12 per cent carbon was used as a base, its wear value being called 1. Heat-treated steels showed wear values from approximately 1.35 to 2.5, compared with this base steel.

* * *

It is stated that nothing ever created by man, except projectiles from guns and rifle bullets, travels faster than the tips of the blades of the turbo-generators built last year by the Westinghouse Electric & Mfg. Co. for the Public Service Co. of New Jersey. These turbo-generators have a speed of 3600 revolutions per minute. The tips of the blades travel 13 1/2 miles a minute, or 810 miles an hour.

Why Are There Several Grades of Widia Cemented-Carbide Materials?

By ROGER D. PROSSER
Thomas Prosser & Son, New York City



An Example of Widia Tooling Equipment—Proper Selection of the Grade of Cutting Metal Insured Long Life between Grinds and Close Tolerances on the Work

THE question has been asked, Why are there several grades of cemented-carbide cutting materials? The answer is simple. Different combinations are required to produce special grades of hard metal compositions for different purposes, just as in the case of high-speed steel, where there are different grades, such as low-tungsten, high-tungsten, and cobalt high-speed steel.

This statement should not be construed to mean that a great many different grades of cemented-carbide materials are required to meet the needs of industry. On the contrary, a comparatively small number of grades will cover all applications for which the super-hard metal compositions are suitable, just as a few grades of high-speed steel cover the range of usefulness of this cutting metal.

It has been definitely established, however, that different grades of cemented carbide are required for different kinds of work. For example, while a grade suitable for interrupted roughing cuts on cast iron may also be used for finishing cuts on the same material, a grade having properties designed especially for finishing will give much better results. For interrupted roughing cuts, a material having the best possible combination of toughness and hardness is required; but for the light finishing cut, toughness is not of such great importance, while resistance to abrasion and ability to produce a fine finish are of the greatest value.

There are grades of cemented carbide which may be applied with success to many different applications throughout the shop. However, for the majority of production shops, better results will be secured by selecting a suitable grade of metal for the particular application in hand, just as a suitable tool shape must be selected for the work to be done.

To illustrate this point, take the case of the cemented carbides known by the trade name Widia. Prosser designations for these cemented carbides and their application are as follows:

Widia Normal (N-349): Standard grade for all usual applications on gray cast iron, brass, and other non-ferrous materials, and work of intermittent character, where the best combination of hardness and toughness is desired.

Widia H-201: Especially designed for the machining of chilled cast iron, gray iron castings with hard spots, marble, glass, and other very hard materials.

Widia L-31: Hard grade especially designed for work where long tool life between grinds, fine finish on the work, and great resistance to abrasion are desired. This grade is for light work on cast iron, brass, bronze, aluminum, etc.; the cutting edge should be finished on a diamond lap.

Widia M-68: This is an especially hard grade for high-speed precision boring operations (so-called "diamond-boring") on certain materials. To be used only for the lightest cuts where the machine runs very smoothly and without vibration. For such operations, it will hold an edge for unusually long periods of time. The cutting edge should be finished on a diamond lap.

Widia X: New grade for machining steel at high speeds. This grade has great resistance to the cratering action or cupping out of the top surface of the tool ordinarily encountered with hard metal compositions, with consequent long life between grinds. This material is the latest grade developed by the Krupp Works in Germany, and was fully described in December, 1931, MACHINERY, page 296. Some examples of the use of this grade of cemented carbide may prove of interest:

In a lathe operation on chrome-nickel steel corresponding to S A E-3335, a cutting speed of 197 feet per minute was used with a feed of 0.060 inch per revolution and a depth of cut of 0.4 inch. After five minutes' use, the tool was examined under a microscope. It showed no cratering action. The chips came off without any tearing action, leaving a fine finish.

In turning S A E-1315 steel with a surface speed of 359 feet per minute, which was the highest speed obtainable on the lathe used, the tool ran for fifteen hours before being reground. Only 0.010 inch of material had to be removed in resharpening.

In facing both ends of a machine-steel bushing for a motion-picture projector—a material highly ductile and difficult to cut—the new tools are run at 1250 revolutions per minute, as against 280 revolutions per minute with high-speed steel. The former time of one minute per piece has been reduced to sixteen seconds. The new tools have cut 4700 pieces without grinding, as against 200 pieces per grind with steel tools, and are being set for another job without regrinding. The work is held to a limit of 0.0004 inch. Ordinary cutting oil is used as a cutting lubricant.

* * *

A New Brazing Alloy

The low melting-point brazing alloy known by the trade name "Sil-Fos," which is manufactured by Handy & Harman, 57 Williams St., New York City, makes it possible to obtain unusually strong, sound, corrosion-resistant joints on copper, brass, bronze, nickel, nickel-silver, Monel metal and other non-ferrous metals and alloys. Among the features of special advantage possessed by this alloy are its low melting point (1300 degrees F.); its great fluidity, which makes it able to penetrate all parts of the joint and alloy with the adjacent metal rapidly; and its self-fluxing characteristics. Copper-to-copper lap joints made with this brazing alloy have shown an average tensile strength of 33,000 pounds per square inch, with an elongation of 17.2 per cent in two inches. The alloy may also be used for filling holes in brass castings.

* * *

Gears & Forgings, Inc. Operates as Usual

Gears & Forgings, Inc., while in the hands of receivers, is operating its plants as usual. Statements to the contrary have been founded on rumors.

While friendly receivership proceedings are being carried out, the receivers are operating the company's business under the direction and order of the Court, so that the company may be continued and the best interests of Gears & Forgings, Inc., and its customers may be served. No changes have taken place in the organization pending the reorganization of the financial structure.

* * *

In 1922, the sale of liquefied gases amounted to about 225,000 gallons; in 1931, the consumption had risen to over 125 times that amount.

Tool and Die Makers Take Contracts from Their Own Firm

Increased earnings for both the employer and the toolmakers have resulted from handling tool and die work under a contract plan in a shop employing some twenty tool and die makers. An article in July MACHINERY will describe how this system works and will outline the advantages that are claimed for the new method. There is a new spirit among the toolmakers. In a sense, they are their own bosses and enjoy it, even though they probably work harder than ever, in order to take advantage of the increased earnings made possible by the new method of operation.

Machinery Manufacturers Express Opinions on Policies

The New England Council has submitted a questionnaire to fifty machinery manufacturers in the six New England States covering various subjects relating to the methods to be used in order to meet present business conditions and opinions as to what might be done by industry collectively and by the Government to prevent similar depressions in the future.

To forestall the effects of the next depression, the majority of the machinery manufacturers suggested that each employer accept definite responsibility for providing the maximum possible security of employment for his stable force, and 23 out of 35 voting recommended setting up reserves to help maintain a weekly income of the stable force during the depression. A majority was against compulsory unemployment insurance established either by the state or federal governments. A three-fourths majority favored the shortening of weekly hours to conform to the work available, while about half suggested that plant expansion should be reserved for depression periods. A large majority favored reserving public works construction for depression periods.

On the subject of banking, the opinions favored a check on loans where common stock is used as the collateral security, as well as on the lending of surplus funds of manufacturing corporations in the call money market.

A strong sentiment was expressed toward a modification of the anti-trust laws, so that firms might cooperate in price stabilization, standardization of discounts, and for the purpose of stopping cut-throat competition. A very strong sentiment in favor of more activity on the part of trade associations was also expressed. These associations should attempt long-time planning for their industries, increase the statistical services, and promote the adoption of scientific management principles.

On the subject of tariffs, 18 out of 50 were in favor of reduced tariffs, 11 wanted an undisturbed tariff, and one favored an increase; 20 manufacturers believed that the tariff should be adjusted case by case by a tariff commission. As regards war debts, 23 manufacturers believed in scaling down the figures, 7 favored complete cancellation, and 13 preferred leaving things as they are.

A national economic council, conducted by business independently of the Government was favored by 14, while 20 favored business and Government cooperation.

Apprenticeship for the Benefit of the Apprentice*

By HAROLD S. FALK, Vice-President and Works Manager
The Falk Corporation, Milwaukee, Wis.

APPRENTICESHIP, or education for the industries, goes beyond the mere teaching of a trade. Day by day we are faced with new problems. We can solve none of them unless we have our men with us. It is our job to show them how we depend upon them and they upon us. We can show this only by giving them as broad an education as possible. At this time, let us consider apprenticeship from the apprentice's point of view.

Consider the young boy who is about to become an apprentice. Who is he? He is a boy who has just completed a primary or a high-school course. He has spent his early years in the shelter of his home. Later, he attended school. The entire system and program of education has created a habit of dependence: His courses are planned for him; his home work is laid out for him; his periods of recreation are under a certain amount of supervision; his parents maintain reasonable contact with the school and cooperate with the school authorities.

A great deal has been said about the value of apprentice training to industry and to the manufacturer. In the present article, Mr. Falk pictures vividly another side of the subject—the importance of apprentice training to the apprentice and to the community of which he is a part. Mr. Falk has for years been an indefatigable worker for improved methods of training young men, in order to fit them for a more important place in industry. In his own plant, he has built up one of the most successful apprentice training organizations in existence.

Then he suddenly graduates and the scene changes abruptly. He is thrown out into a bewildering world and left to his own resources. The governing agencies on which he has depended instantly cease to function. He is entirely dependent upon himself. His parents assume that he is prepared to take his place in the world. He has had no warning concerning the movements and tendencies of which he is now a part. All in all, he is very much at a loss. He reaches about for some apparently secure influence to which he may fasten himself.

It is lucky for him, if, at this time, a friend suggests that he should become an apprentice. He has always been interested in mechanical work, and so he approaches an employer and asks to be made a machinist's apprentice. He finds, in the organization he joins, precisely the stable institution that he craves. He finds a department established to take care of him. He finds a program of work which reaches four years ahead, or until he reaches maturity. He finds that the employer is willing to agree to retain him in his employ during good behavior until the work program is completed, when he will be a qualified mechanic with a trade and a skill to depend upon in working his way through the world. He signs a contract of apprenticeship and finds that his parents are again as much interested in the work at the shop as they were in his studies at school.

He attends apprentice classes and is taught the fundamentals of the work in which he is engaged; in addition, he becomes familiar with the position of industry in the American scheme of things, and learns to appreciate the dignity of work, the superior satisfaction of home and friends, and the value of American social and civic institutions.

He works in a shop where the foremen and instructors take a real interest in him—a personal interest quite distinct from the interest in the work he is doing. He asks questions and finds that the instructors will go out of their way to answer him clearly and fully.

He gets into an argument with a foreman and loses his temper. He expects to be fired at the close of the day; but his expectations are not realized. He is summoned to the office of the apprentice supervisor, and is given an opportunity to state his case. He may be in the wrong, but his wrong is explained to him and he is shown how he can mend his ways. To his great surprise, the supervisor discusses his case with the foreman, and arrangements are made for him to resume his work. He finds the foreman as friendly and cooperative as he has ever been.

He completes his course and receives a bonus and certificate of apprenticeship. This certificate is merely a document, but it implies a great deal. It is signed by the officers of the employing corporation. As long as he lives, those signatures attest the confidence which the employer had in him and the employer's willingness to vouch for his skill, ability, and personal integrity. He may not remain with this employer, but he feels for him a loyalty much like the loyalty of a college man for his alma mater.

This loyalty is not an accident; it is inevitable.

*Abstract of a paper read before the American Gear Manufacturers' Association at Cleveland, Ohio, May 12.

It arises from the care and attention and interest of the employer, beginning at a time when the boy feels utterly alone in the world and does not know where to go or what to do. He has come to realize that he may place confidence in his employer and in the industrial and social system of which his employer is a representative.

I do not state this as a matter of opinion; I can prove it from experience. During the last year and a half, our business has been no better than anybody else's. We have adopted a policy of rotating the work so all share in what work there is. The apprentices have shared in this arrangement on an equal basis with other single employes.

In all this trying period of a year and a half, when our apprentices are making a bare living or less, because their share of the work is so small, there have been complaints, to be sure, by the apprentices to the supervisors; complaints about the distribution of work; complaints that this or that boy has had more opportunity than someone else; complaints about efforts to hurry work along when there was very little work to do, and so on. But there has not been a single protest against the institution of the corporation itself or against its fundamental policies; nor has there been even a hint that our present institutions are failures or that the depression is any more than an unavoidable interruption to our normal progress.

This country of ours has experienced trying times before. I am certain that we shall come out of this period as we have in the past—poorer perhaps in material wealth, but richer in experience and better prepared to carry on our life work. Furthermore, I am sure our apprentices and apprentice graduates will play no small part in our recovery.

Gear Manufacturers Hold Annual Meeting

The American Gear Manufacturers' Association held its sixteenth annual meeting at the Hotel Statler, Cleveland, Ohio, May 12 and 13. At this meeting, the following officers were elected for the coming year: President, E. W. Miller, Fellows Gear Shaper Co., Springfield, Vt.; first vice-president, John Christensen, Cincinnati Gear Co., Cincinnati, Ohio; second vice-president, A. A. Ross, General Electric Co., Lynn, Mass.; treasurer, J. Harper Jackson, Pittsburgh Gear & Machine Co., Pittsburgh, Pa.; secretary, J. C. McQuiston, Pittsburgh, Pa.

At the opening session, the past-president of the Association, B. F. Waterman of the Brown & Sharpe Mfg. Co., Providence, R. I., briefly reviewed the present trying conditions in industry. In spite of industrial difficulties, the work of the Association has gone forward, and many of the standardization and other committees made reports at the meeting that gave evidence of the serious work that is in progress. A report by the spur gear committee on computing the allowable tooth loads of metal spur gears was accepted as proposed recommended practice.

A number of papers were presented on technical and commercial subjects. L. R. Mayo of the Brown & Sharpe Mfg. Co., read a paper entitled "Design and Use of Worm-gear Hobs," which gave fundamental rules based on many years of gear-cutting practice. Harold S. Falk of the Falk Corporation, addressed the meeting on the subject of apprenticeship. An abstract of this paper will be found on page 772. Richard Ferguson of the Ferguson Gear Works, spoke on "The Gear Industry in North Carolina," and A. B. Cox read a paper entitled "New Light on the Strength of Gear Teeth."

An entire session was devoted to the work of the commercial standards committee. At this session E. S. Sawtelle of the Tool Steel Gear & Pinion Co., spoke on business ethics, bringing out points of great importance to industry. "American industry has always been overly volume-minded," said Mr. Sawtelle. "We always kid ourselves by thinking that if we could just get a little more business, all of our problems would be solved. The fact of the matter is that often companies that get the most business show the least profit or the greatest losses, while frequently a company that stays small, satisfies itself with a restricted field, and gives intensive service and attention to a limited number of customers is the company that ends up on top. When a volume-minded president or board of directors cracks the whip, the sales department sometimes feels forced to go to extremes that it would not otherwise countenance.

"We must always remember that non-ethical practices, ridiculous price-slashing, and unfair competition do not appreciably increase the total volume of purchases. It may momentarily disturb the normal ratio of distribution to various companies, but in the long run even this ratio is not seriously affected.

"There is a distinction between trade practices that are non-ethical and trade practices that may hurt. Nothing in the introduction of the automobile violated the ethics of the buggy-makers; but it wrecked their business. Industry advances through progress; the man with better service, better quality, or superior engineering has a right to the fruits of his ability and is entitled to our respect, even though he may be seriously treading on our toes."

At the Commercial Standards Session, J. Harper Jackson of the Pittsburgh Gear & Machine Co., read a paper on "Low-pressure Selling," and H. N. Mathias of the Westinghouse Electric & Mfg. Co., spoke on the subject "Overhead Control as Part of Standard Costs."

Can Tungsten-Carbide Tools be Used Successfully on Planers?

By COLEMAN SELLERS, 3rd
William Sellers & Co., Inc., Philadelphia, Pa.

TUNGSTEN-CARBIDE tools can be used successfully on planers. This we have demonstrated many times. However, after considerable experience we have come to the conclusion that tungsten carbide is not satisfactory for general use on this type of machine tool. This is partly due to the human element. The tools will not stand much abuse, and exceptionally good judgment must be used in handling the tools and setting the speeds and feeds.

The principal difficulty lies in the inherent weakness of tungsten carbide. The shock of entering the cut makes it desirable to reduce the top side rake and eliminate the back rake or even make it negative. This has the effect of increasing the chip pressure to a point where it is likely sooner or later to break down the cutting edge.

Light cuts would be more satisfactory, but the metal would not be removed fast enough to offset the increased cost of the tools, since the speed cannot be increased so readily as on other types of tools, such as lathes or boring machines. Not many planers have a cutting speed in excess of 80 feet per minute, and to make the new tools economical, speeds between 200 and 250 feet per minute should be used. Even if the planer table were made to run at that speed, the shock of entering the cut would be great, and a special control would be necessary to speed up after the cut had started.

Tungsten carbide can be used on planers to advantage where high-speed steels will not cut. When the iron is very hard, has a hard scale, or contains sand, it will be found to stand up much better than ordinary tool materials. The speeds and feeds must be set to suit the specific conditions, but in this case, we are not so much concerned with increasing the amount of metal removed per minute, compared with high-speed steel tools, as the latter will not cut at all, and it is not difficult to show an improvement.

In using tungsten carbide on planers, care must be taken not to allow the tool to drag on the return stroke. The planer should be equipped with automatic tool lifters or the heads should be lifted by hand, so that the tool will not touch while the table is returning. The stops should be set as close to the end of the work as possible, so that the speed at entering the cut will be slow. Then, of course, the tool shank should be of large proportions and the overhang reduced to a minimum.

The manufacturers of this material are steadily improving their product, and the time may not be far off when the foregoing may not apply. Tungsten carbide as sold now is entirely different from what it was three years ago, and the strength has been much increased. What further developments may occur is difficult to foretell, but it seems certain there will be developments.

The American Society of Tool Engineers

The American Society of Tool Engineers was recently organized with headquarters at 8316 Woodward Ave., Detroit, Mich. The purpose of the Society is to advance the knowledge of tool engineering, to bring about good fellowship among the members, to hold meetings for the reading and discussion of professional papers, and to publish such papers and reports.

There are two grades of members—senior and junior. A senior member shall be either a tool engineer having recognized ability to plan the order of operations and to lay out and supervise the design and manufacture of tools and equipment; or a tool, die, or machine designer having five years' experience; or an executive having knowledge of tool engineering for mass production. Senior members must be at least twenty-five years of age.

Any tool designer having less than five years' experience or any student in a recognized school or college studying tool designing or tool engineering may become a junior member.

Meetings will be held regularly on the second Thursday evening of each month in Detroit. At the last meeting, H. A. Woofter, chief engineer of the Swift Electric Welder Co., was the principal speaker, the subject being "Production Welding."

The following officers have been elected for the coming year: President, J. A. Siegel, assistant chief tool designer, Packard Motor Car Co.; first vice-president, W. H. Smila, tool engineer, Chrysler Corporation; second vice-president, E. J. Ruggles, chief tool designer, Gemmer Mfg. Co.; secretary, A. M. Sargent, president and general manager, Pioneer Engineering & Mfg. Co.; treasurer, W. J. Fors, tool engineer, Detroit, Mich.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies Can be Obtained by Writing Directly to the Manufacturer, Mentioning MACHINERY.

GEAR-HOBBING MACHINES. Barber-Colman Co., Rockford, Ill. Booklet entitled "Economical Hobbing," containing an explanation of the factors involved in getting the most satisfactory results from gear-hobbing machines. Booklet entitled "Precision Hobbing," containing a summary of the problems encountered in gear-cutting where accurate work with good finish is required. Booklet entitled "Helical Gears," containing the results of an extensive investigation to determine the causes of inaccuracies in helical gears and the means for producing helical gears that are consistently accurate. The charts from which the conclusions were drawn are presented in the pamphlet. Those interested in the hobbing of gears will find much valuable information in these booklets.

INDUSTRIAL FURNACE EQUIPMENT. W. S. Rockwell Co., 50 Church St., New York City. Bulletins 325 and 331, outlining, respectively, the features of Rockwell blast gates and Rockwell centrifugal compressors for industrial furnace service. Bulletins Nos. 327, 328, 330, 332, 333, and 334, illustrating and describing, respectively, rotary carburizing furnaces, rotary heat-treating furnaces, electric and fuel industrial furnaces, electric convector furnaces, continuous electric and fuel furnaces, and non-ferrous billet-heating furnaces.

RUBBER PRODUCTS. B. F. Goodrich Rubber Co., Akron, Ohio. Booklet entitled "A Wonder Book of Rubber," containing the story of the manufacture of rubber and the use of rubber products. The booklet is not written as a scientific discussion, but rather in popular style, and was prepared in response to a request for general information about the rubber industry. It describes the manufacture of rubber products, starting with the rubber in its crude state and carrying it through the various steps in the manufacturing process.

WELDING RODS. Bastian-Blessing Co., 240 E. Ontario St., Chicago, Ill. Catalogue covering a new line of welding rods and electrodes designated by the trade name of "RegOroD." The catalogue is pocket size, and contains a complete description of each rod, as well as information on the proper rod to use for specific applications. There are also a number of valuable tables for the welder and welding engineer.

LATHES. Monarch Machine Tool Co., Sidney, Ohio. Catalogue entitled "Monarch Model C Tool-room Lathes," illustrating and briefly describing special features of these machines and the methods used in their inspection. The photographic work in this catalogue is of a very unusual character, remarkable results having been obtained in many instances without any retouching of the photographs.

SURFACE GRINDING MACHINES. Blanchard Machine Co., 64 State St., Cambridge, Mass. Catalogue descriptive of Blanchard automatic surface grinders (Nos. 16-A and 16-A2) of the single-spindle and double-spindle types. In addition to describing the construction of the two types of machines, typical work performed on these machines is illustrated and production data are given.

BALL BEARINGS. Auburn Ball Bearing Co., Rochester, N. Y. Ball-bearing data book, containing information on the types of ball bearings made by this company. Descriptions of bearings, mounting instructions, dimensions, lists of stock sizes, and tables of capacity are arranged for quick reference. Data on special types of bearings and bearing installations are also given.

TESTING EQUIPMENT. Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa. Catalogue 50, Part H, containing detailed descriptions of Olsen miscellaneous testing machines. The catalogue covers machines for testing the efficiency of cutting or abrasion tools, alternate stress in materials, impact, torsion, cold bends, hardness, oil and bearing metal, and for other special purposes.

ARC-WELDING SUPPLIES. Lincoln Electric Co., Cleveland, Ohio. Bulletin known as Section 3304, covering a complete line of supplies for arc welding. A full description, with prices, of electrode-holders, cables, protective shields, protective lenses, protective clothing, and various supply parts is included, as well as a description of electrodes for all kinds of arc welding.

LATHES. South Bend Lathe Works, 774 E. Madison St., South Bend, Ind. Booklet 8, illustrating and describing the newly developed small shop lathe known as the 8-inch Junior, which is applicable to maintenance, repair shop, experimental, and manufacturing work. The bulletin contains more than thirty illustrations showing set-ups of this machine for various operations.

ELECTRIC EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Circular 1937, descriptive of Type AB "De-Ion" 225-ampere circuit-breakers. Circular 1939, entitled "New and Revolutionary Low-Voltage Circuit Protection," containing a general description of the "De-Ion" circuit-breakers, breaker ratings, and applications.

BRAZING EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletin GEA-1291, containing considerable technical information on copper brazing and copper-brazing furnaces. Circular GEA-1311A, descriptive of GE electric brazing equipment for brazing or hard-soldering brass, copper, bronze, or steel in repair or production work.

DIE-HEADS. Geometric Tool Co., New Haven, Conn. Loose-leaf bul-

letins illustrating and describing Geometric rotary self-opening die-heads for use in live-spindle machines, and Geometric stationary self-opening die-heads for use in hand screw machines, turret lathes, and similar equipment.

MATERIAL-HANDLING EQUIPMENT. Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. Bulletin entitled "Select the Tools Best Suited to Your Needs," illustrating the use of the Cleveland overhead tramrail system for handling materials in the automotive industries.

ELECTRICAL MEASURING AND PROTECTIVE APPARATUS. Roller-Smith Co., 233 Broadway, New York City. Catalogue 5, covering air circuit-breakers of both the open and enclosed types; attachments and accessories of all kinds; relays and sectional-steel dead-front switchboards and cubicles.

GEARS. Charles Bond Co., 617 Arch St., Philadelphia, Pa. Catalogue 56, listing the 1619 different sizes of gears and sprockets carried in stock by this company, ready for immediate shipment. The line of gears includes spur gears, worm-gears, spiral gears, bevel gears, internal gears, etc.

LUBRICATORS. Manzel Bros. Co., 309 Babcock St., Buffalo, N. Y. Catalogue 31, describing the construction and operation of the Manzel force-feed lubricator, which is applicable to practically all classes of machinery. The circular illustrates the various models and contains a table of prices.

ELECTRIC HEATING EQUIPMENT. H. O. Swoboda, Inc., 3530 Federal St., Pittsburgh, Pa. Bulletin 270, illustrating one type of the Falcon bare electric immersion heating units, suitable for heating oil, varnish, compounds, and similar viscous materials that are electrical insulators.

METAL-WORKING MACHINERY. J. L. Lucas & Son, Inc., Bridgeport, Conn. Lucas List No. 81 of rebuilt machinery, containing a complete list of rebuilt metal-working machines offered by this concern, many of which are illustrated. The book is provided with an index for ready reference.

SHEARS. United Engineering & Foundry Co., Pittsburgh, Pa. Bulletin E-902, illustrating and describing United miscellaneous light shears for cropping front and rear ends and for dividing bars, rods, shapes, strips, and other pieces in connection with rolling mill work.

LOCK-WASHERS. Shakeproof Lock Washer Co., Division of Illinois Tool Works, 2501 N. Keeler Ave., Chicago, Ill. Circular describing the features and advantages of Shakeproof lock-washers, designed to keep connections locked tight, even when subjected to vibration.

SPOT-WELDING MACHINES. Eisler Electric Corporation, 69 S. 13th St., Newark, N. J. Catalogue W, illustrating and describing the various types of Eisler electric speed spot-welding machines. Complete specifications of the various types and sizes are included.

REELING MACHINES. United Engineering & Foundry Co., Pittsburgh, Pa. Bulletin N-301, illustrating and describing various types of hot strip reels for the reeling, coiling, winding, rewinding, recoiling and coil-opening of hot-rolled metal strips in rolling mill work.

WIRE ROPE. American Cable Co., Inc., 230 Park Ave., New York City. Pamphlet entitled "The Cardinal Reasons Why You Save Money with Tru-Lay Preformed Wire Rope," describing the characteristics and advantages of this type of wire rope.

GRINDING MACHINES. National Tool Co., Cleveland, Ohio. Booklet containing a detailed description of the National-Cleveland radial helicoid grinding machine—a staggered-tooth, helical-gear shaped cutter sharpening machine.

STAINLESS AND HEAT-RESISTING PIPES AND TUBES. National Tube Co., Pittsburgh, Pa., Catalogue describing the National U.S.S. stainless and heat-resisting pipe and tubes, and the various applications for which they are adapted.

STAINLESS AND HEAT-RESISTING STEELS. United States Steel Corporation, 71 Broadway, New York City. Catalogue describing the composition, properties, and applications of U.S.S. stainless and heat-resisting alloy steels.

SPECIAL EQUIPMENT. City Machine & Tool Works, East Third and June Sts., Dayton, Ohio. Circular entitled "On Time, and in Operation One Hour After Arrival," describing a typical job undertaken by the company.

WIRE-FORMING MACHINES AND AUTOMATIC LATHES. Baird Machine Co., Bridgeport, Conn. Circular illustrating the use of Baird automatic lathes, wire-forming machines, automatic presses, tumbling barrels, etc.

OPTICAL EQUIPMENT. Bausch & Lomb Optical Co., 619 St. Paul St., Rochester, N. Y. Circular descriptive of the unified slit ultramicroscope, a new instrument developed to simplify the study of colloids.

FLEXIBLE COUPLINGS. Charles Bond Co., 617 Arch St., Philadelphia, Pa. Circular describing the construction of five different types of Bond flexible insulated couplings.

SCREW MACHINE PRODUCTS. Fischer Special Mfg. Co., Cincinnati, Ohio. Circular containing list prices of the line of "turned" hexagon brass nuts made by this company.

WELDING MACHINES. Lincoln Electric Co., Cleveland, Ohio. Application Sheet No. 29 in a series on the elements of design, discussing the design of welded levers.

HIGH-SPEED GEAR UNITS. Farrel-Birmingham Co., Inc., 377 Vulcan St., Buffalo, N. Y. Bulletin 425, containing data on Farrel-Sykes high-speed gear units.

ELECTRIC EQUIPMENT. Electric Products Co., Cleveland, Ohio. Bulletin 55, illustrating and describing diverter pole generators for motive power batteries.

MOTORIZED SPEED REDUCERS. Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill. Circular outlining the features of the Janette motorized speed reducer.

HACKSAWS. Victor Saw Works, Inc., Middletown, N. Y. Leaflet containing data, including prices, on Victor molybdenum heavy-duty hacksaws.

PIPE TOOLS. Borden Co., Warren, Ohio. Folder 232, containing data on the improved line of Beaver pipe tools, including prices.

MOTORS. General Electric Co., Schenectady, N. Y. Circular GEA-1542, descriptive of General Electric Type B direct-current motors.

Shop Equipment News

Machine Tools, Machine Parts, Unit Mechanisms and Material-Handling Appliances Recently Placed on the Market

Sellers Huge Cylinder Boring and Facing Machine

Cylinders up to 96 inches in diameter can be handled in a special boring and facing machine of mammoth proportions recently built by William Sellers & Co., Inc., Philadelphia, Pa., for the National Transit Pump & Machine Co., Oil City, Pa. This machine bores and faces at one setting the cylinders and guides of large engine and booster pump units. Because of its flexibility, however, the machine will also handle cylinders of almost any kind.

The work-table is 23 feet long by 8 feet wide, and accommodates work up to 22 feet long. The boring-bar is 12 inches in diameter and 43 feet 8 inches long. Its center is located 54 inches above the table. The total bed length is 48 feet 8 inches, the main bed section being a single casting 36 feet long and weighing 80,000 pounds. The weight of the complete machine is approximately 162,000 pounds.

The boring-bar is supported by two heads, one of which is stationary and serves as a driving unit, while the other—the tailstock—is adjustable longitudinally on the bed. Each head is equipped with a heavy steel facing arm, as seen in Fig. 1. While this arm is driven by the boring-bar, it is mounted in a long revolving sleeve through which the bar passes. A tool-rest with multiple tool slots is adjustable in a radial direction on each arm, by means of a novel feed mechanism. Locks actuated by levers permit the facing arms to be engaged and disengaged while the bar is revolving.

The bar has a 6-inch hole extending throughout its length. At the working end, it is bored to receive cutter-head shanks or smaller bars. Two full-length keyways, 180 degrees apart, provide for keying the bar to the revolving sleeves in the two heads. With this construction, wear on the bar due to rotation is eliminated. The bar slides freely in the sleeves when being fed or traversed.

A 40-horsepower motor drives the bar through a speed-change box which provides speeds from 1 1/2 to 30 revolutions per minute. An intermediate gear train drives a 60-inch herringbone gear attached to the revolving sleeve in the fixed head. The main driving motor also provides the bar feed through positive gearing and a feed-change box. Three roughing and three finishing feeds are available in either direction. In addition, there is a power traverse at a speed of 16

feet per minute, obtained through a separate 7 1/2-horsepower motor. Convenient hand adjustment is also provided.

The stroke of the bar is 24 feet, in three increments of 8 feet each. Automatic knock-outs, which are adjustable to any position, disengage the feed or traverse at the end of the stroke. A five-horsepower motor is mounted on the tailstock for traversing this unit.

For use in boring long engine-bed assemblies, there is an intermediate or "gallows" support for the boring-bar. This support is designed to provide clearance on each side of the bar, as well as below. It is easily moved or relocated on the work-table, and if desired, the entire structure can be taken off the machine. In setting up work, it is only necessary to remove the upper portion of this support.

Three auxiliary supports (two of which can be seen in the heading illustration) are required to hold the bar when it is withdrawn at the rear of the machine. These supports, as well as the "gallows" support, are equipped with revolving sleeves. Disappearing keys are depressed when the bar enters the sleeves and spring outward to engage the keyways of the bar when it begins to rotate.

All parts of the machine that move constantly are oiled by gravity from conveniently located central tanks, except in the case of isolated bearings. However, gear-boxes are oiled by splash and by conveyors that insure a constant flow of oil through the ball bearings and over the gears. A "one-shot" system is furnished for units that are moved intermittently, such as the tailstock.

The three ball-bearing motors, as well as all the electric equipment, are mounted directly on the machine. From Fig. 2 it will be seen that power is delivered to the motor of the adjustable head through a cable that is kept taut by means of a spring reel. Limit switches prevent over-running of the bar.

Two operating positions increase the flexibility of the machine. The operator has full control of all motors from either head, and the bar can be started, stopped, traversed, or fed in either direction by hand or power through duplicate levers and push-button stations.

Cincinnati Geared-Head Lathes with Timken Bearings

All sizes of the geared-head lathes manufactured by the Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati, Ohio, can now be obtained with either bronze or anti-friction bearings. Not only can the headstock be furnished with Timken roller bearings, but other units, including the gear-box and apron, can also be equipped with anti-friction bearings. The line includes lathes from 16- to 32-inch swing.

These lathes are provided with twelve mechanical spindle speeds in geometric progression, and thirty-two feeds from 0.004 to 0.240 inch per spindle revolution. Twenty-four spindle speeds, or ninety-six changes of thread and feed, are available. Either alternating- or direct-current motors, mounted within the leg, can be supplied for driving the machines through silent chains, endless belts, multiple V-belts, or gears. The lathes are available with beds 6 feet long and upward, varying by two feet.

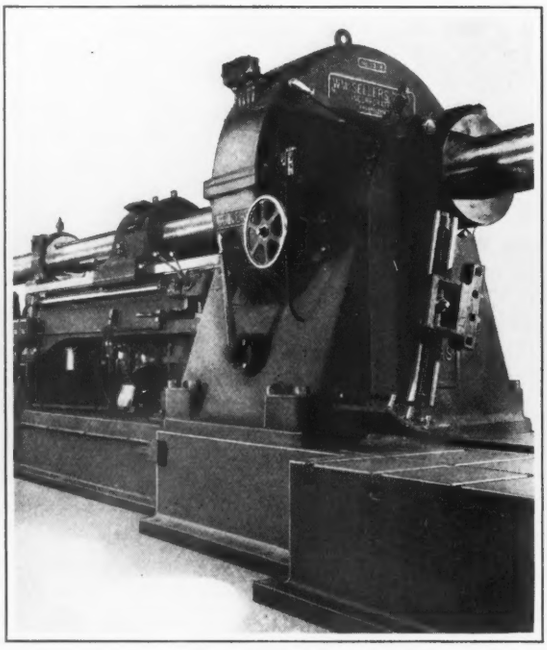


Fig. 1. The Stationary Head of the Sellers Boring and Facing Machine for Machining Large Cylinders

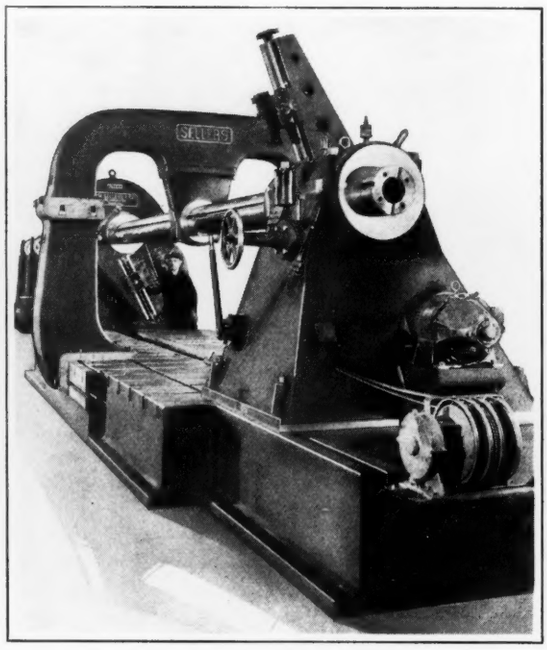


Fig. 2. View of the Adjustable Head or Tailstock and of the Reel which Keeps the Motor Cable Taut

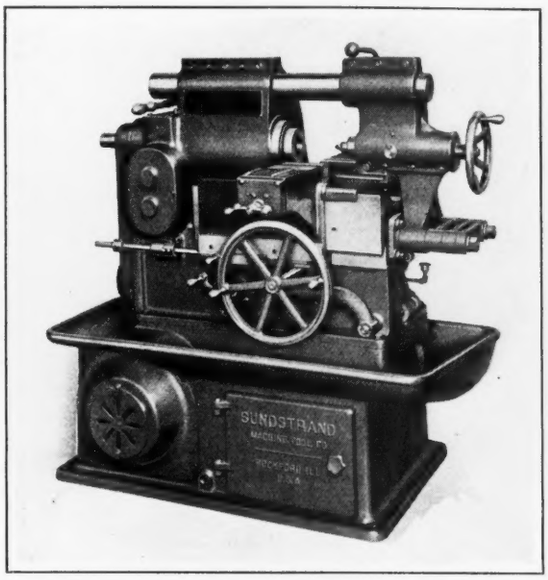


Fig. 1. Sundstrand Stub Lathe in which Many Improvements are Incorporated

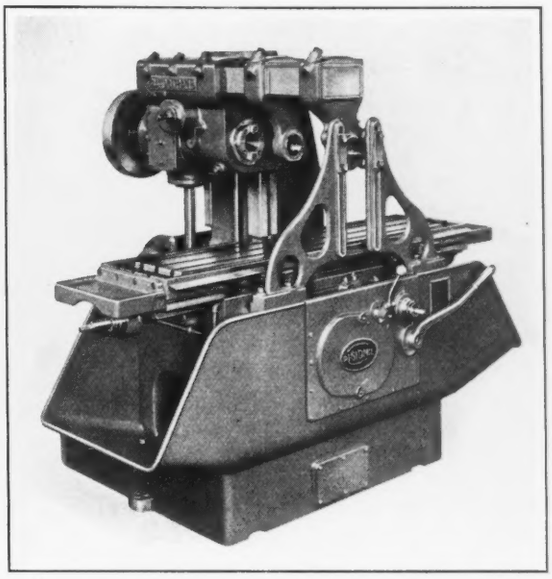


Fig. 2. Rigidmil which also Embodies Many Improvements over the First Model

Sundstrand Stub Lathe and Rigidmil of Improved Designs

In the years that have passed since the Sundstrand Machine Tool Co., Rockford, Ill., first brought out the stub lathe and Rigidmil, certain changes in design have been made from time to time, and as they proved desirable, have been incorporated in the standard machines. Each of these machines, therefore, is now considerably different from the models previously described in MACHINERY, although they retain the basic elements of the original designs.

The present stub lathe does not look very different from the one described in November, 1922, MACHINERY, page 231. However, a number of improvements have been made, including a compact base of a design that facilitates the handling of chips and that contains a motor compartment, coolant reservoir, and chip pan; a one-piece bed and headstock with a large opening through which the chips fall; a heavier front slide; a larger quill for the tail-center; and a heavier tailstock which is supported both above and below the center line.

The tailstock is now secured to the bed by two large studs. The front carriage is of a heavy design, and is regularly made for mounting a taper- or form-turning attachment. There is a new drive for the carriage feeds, which has made possible more chip room through the bed. More space has been provided between the rear slide and the headstock. The rear slide has been made stronger and is provided with a new in-and-out adjustment.

That the present Rigidmil differs considerably in outward appearance from the first model will be apparent from Fig. 2. Improvements made in this machine include a larger one-piece frame casting; a larger feed-box, with an increased range; a larger coolant reservoir and chip screen; and a stronger feed-trip mechanism.

A welded steel extension with gaskets, bolted to the base, keeps chips and coolant off the floor. The over-arm braces, clamps, and mounting are of an improved design. Anti-friction bearings are regularly provided for the spindle. The spindle head is of an improved design, and a special high-speed drive can be applied to it at any time.

Other improvements include a new quill adjustment, new grease retainers, a heavier elevating screw, a more powerful main drive, a stronger feed-screw, and better facilities for handling chips. There is also a new guard for protecting the table control dogs, and a simplified means of clamping the spindle head. The standard rapid traverse rates have been practically doubled in the new model.

Oxweld Oxygen and Acetylene Regulators

The Linde Air Products Co., 30 E. 42nd St., New York City, has recently added the Oxweld Type R-48 oxygen regulator and the Oxweld Type R-49 acetylene regulator to its line of welding and cutting apparatus. These new regulators are of a light-duty design and are particularly intended for use with the Type W-15 welding blow-pipe which is included in a sheet-metal welding outfit. A new type of safety release is incorporated in the oxygen regulator. The bonnet of these regulators is held in place by a forged-brass cap-ring which insures a non-leaking diaphragm.

National Automatic Electric Header

An automatic heading machine in which is embodied an electric heater that heats the stock to the desired temperature for the operation is shown in Fig. 1. This machine is being placed on the market by the National Machinery Co., Tiffin, Ohio, which concern is exclusively licensed to build the machine under the Kobert patents. The cold stock is fed from a coil, cut to length, heated to the forging temperature, and then headed.

The heating is accomplished progressively in three stages through low-voltage transformers. Only the portion of the stock to be headed is heated. Fig. 3 shows a close-up view of the heating terminals, the heading slide being in the right foreground. The heating is fast, and the time interval between the heating and heading is so brief that there is little opportunity for scale to form. It is claimed that with this process, the heads produced possess, physically and metallurgically, the quality of hot-headed work, while the shanks have a bright finish equivalent to that of cold-headed solid-die work.

The machine is adapted for

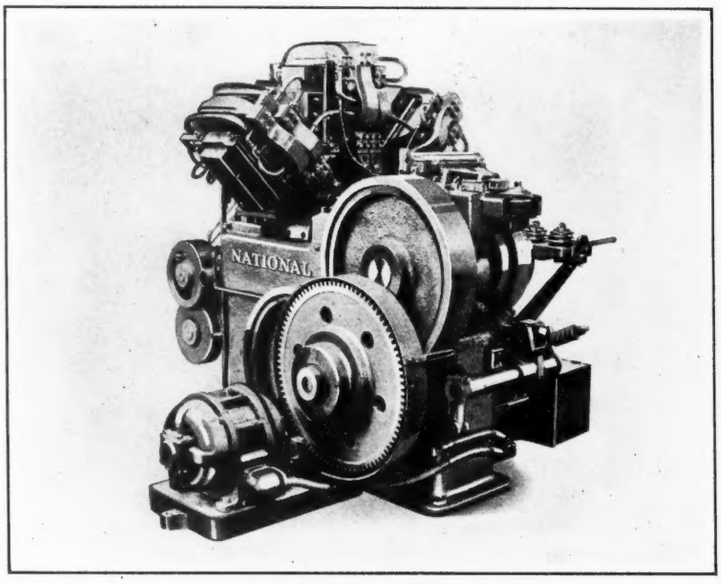


Fig. 1. National Automatic Header with Electric Means for Heating the Stock

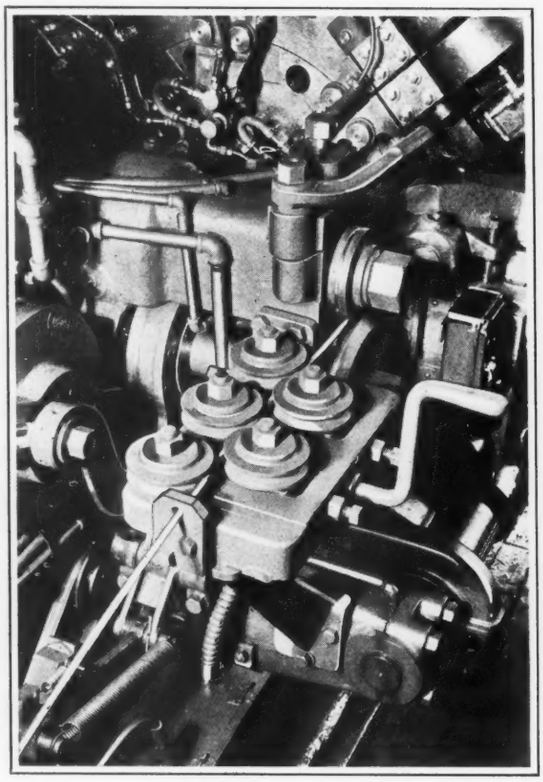


Fig. 2. When the Stock is Fed from a Coil it Passes between Straightening Rolls

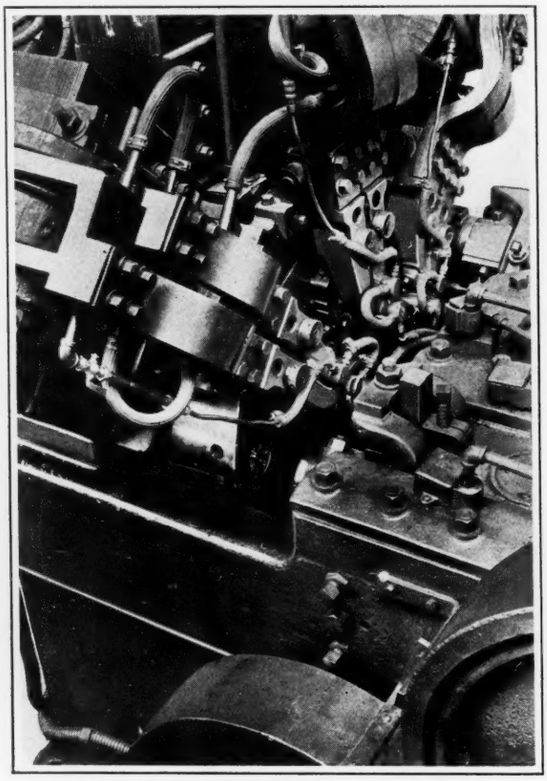


Fig. 3. View of the Heating Terminals; the Heading Slide is at the Right

both steel and non-ferrous metals. It is stated that alloy steels which cannot be cold-headed can be successfully headed in this machine. Non-ferrous metals which, when cold-headed, require two and three subsequent reheadings with an anneal before each reheading can be headed in the new machine in one stroke without annealing.

Fig. 2 shows the stock entering the machine between straightening rolls after leaving a coil. The machine may also be equipped with a magazine for feeding blanks cut to length. With a magazine feed, blanks can be headed that have previously been threaded or machined on the end opposite the head. As the operation of this electric header is continuous and a finished piece is ejected at every stroke, it is possible to obtain high rates of production.

Lucas boring, drilling, and milling machines of all sizes can now be equipped with an auxiliary "Hi-Speed" drive to the main spindle. Multiple V-belts in this unit comprise the final drive to the spindle. The high-speed unit cannot be engaged until the large spur gears that transmit the slower speeds have been disengaged.

Fig. 2 shows a No. 41 machine equipped with the auxiliary high-

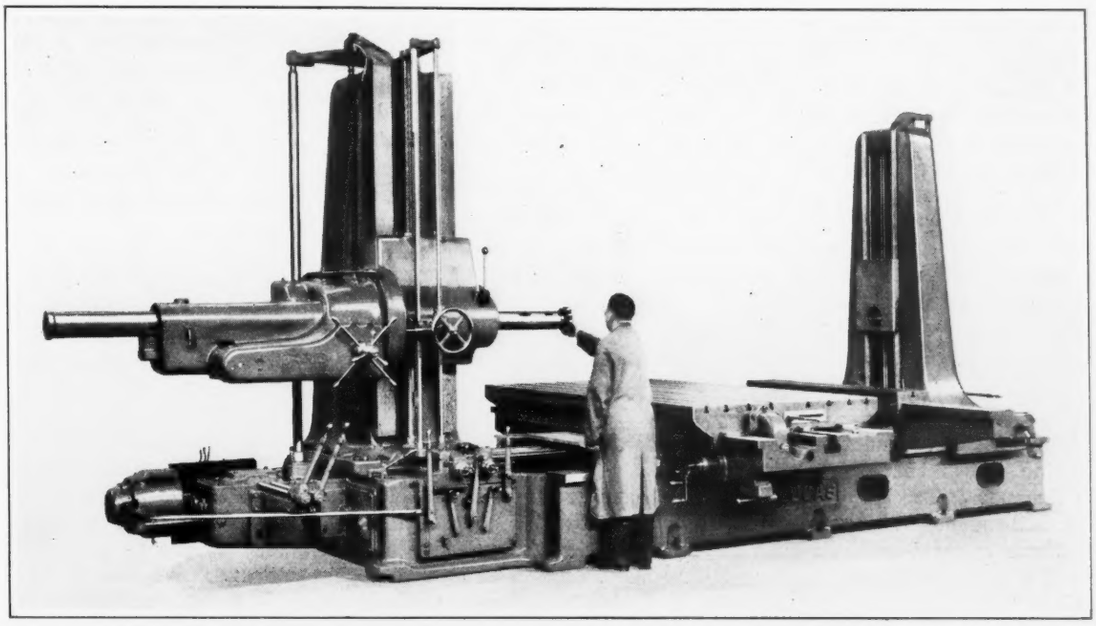


Fig. 1. Capacity for Large Work is a Feature of the Lucas No. 53 Boring, Drilling, and Milling Machine

Lucas Large-Size Boring Machine and "Hi-Speed" Spindle Drive

Capacity for large work is a feature of the No. 53 "Precision" horizontal boring, drilling, and milling machine recently brought out by The Lucas Machine Tool Co., Cleveland, Ohio. On the standard machine the maximum distance from the top of the table to the center of the spindle is 60 inches, the automatic cross-feed of the 48- by 96-inch table is 84 inches, and the spindle has a traverse of 72 inches. However, the machine can be built to special order with a maximum vertical capacity of 72 inches, a table 60 inches wide, and a bed of several special lengths varying by intervals of 2 feet.

In order to guard against sagging of the table in its extreme positions, a long deep saddle is provided, and the bed is unusually wide. The saddle is 10 feet long and the bed measures 60 inches across the outer two of the three ways. The bed is a one-piece casting that supports not only the table unit and the outer support for the boring-bar, but also the column. This construction is used with a view to keeping the column square with the bed ways and increasing the rigidity of the machine. Recesses in the bed provide toe-room for the operator so that he can reach the tools while standing erect.

speed drive. It provides six additional spindle speeds for this small size machine, and seven added speeds for larger machines. Equipped with this drive, the 3-inch spindle of the No. 41 machine has a range of speeds from 13 1/2 to 1200 revolutions per minute; the 4-inch spindle of the No. 42 machine has a range from 9 to 1000 revolutions per minute; and the 5-inch spindle of the Nos. 43 and 53 machines has a range from 7 1/2 to 860 revolutions per minute.

These speeds permit the use of a 1/4-inch drill at 80 feet per minute or boring and facing heads up to 30 inches in diameter at 60 feet per minute for cast iron. Cutting speeds up to 300 feet per minute can be employed

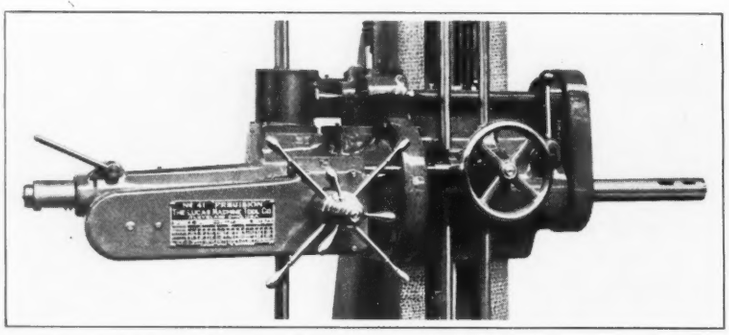


Fig. 2. An Auxiliary "Hi-Speed" Drive Can Now be Applied to the Main Spindle of Lucas Boring Machines

when using tungsten-carbide cutters on cast iron, and up to 1000 feet per minute when using them on aluminum, even in the case of comparatively small end-mills.

One advantage pointed out for this method of supplying the full range of speeds for the main spindle is that the stiffness of the spindle and of the large tool shank that it will take is particularly desirable when the spindle is extended a considerable distance for stub-boring or end-milling. Another advantage is that the same spindle can be used for boring and drilling both large and small holes, with a single positioning of the spindle head, at any height within the range of the machine and without indexing for center distances.

Kearney & Trecker Six-Spindle Milling Machine

A special six-spindle milling machine was recently built by the Kearney & Trecker Corporation, Milwaukee, Wis., for milling three exhaust pads on each side of a new automobile cylinder block of the V-8 type. This machine was designed throughout to permit the use of tungsten-carbide tools. It weighs approximately 13,300 pounds.

The two three-spindle heads on the sides of the bed are fed upward together on their angular slides so that all six pads of the cylinder blocks are milled simultaneously. Each head is driven by a 7 1/2-horsepower motor. Although the heads are arranged to operate simultaneously at a feed of 15 inches per minute, individual feeds are available. Feed changes are made by means of pick-off gears located between the motor and the flywheel, as will be apparent from Fig. 1. All the spindles are mounted in quills that permit individual adjustment to compensate for cutter wear. Graduated dials facilitate adjustments.

The cycle of the machine is entirely automatic; both heads move upward at the rate of 15 inches per minute until the six pads are milled, at which time the feed is automatically disengaged and the heads are reversed at a rapid traverse rate of 150 inches per minute. Both heads, as well as the work-fixture, can be operated from either side of the machine by means of a dual control.

The machine has been installed directly in a conveyor line, so that the cylinder blocks roll into it from one side, are clamped, milled, and finally roll out on the opposite side. Each cylinder block is located approximately in the fixture by a stop, and is accurately located by two disappearing dowels. It is then clamped by the large handwheel. The fixture is made entirely of steel.

Cored openings in the bed on each side of the fixture permit the chips to fall into the bed. They can be easily removed through two large holes at the back of the machine. Production is maintained at the rate of one block every forty seconds.

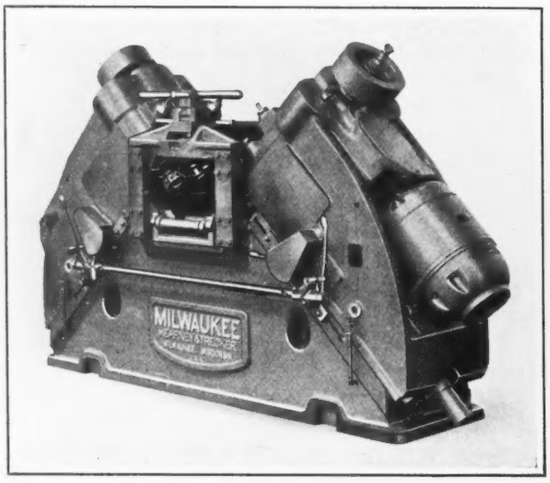


Fig. 1. Milwaukee Six-spindle Machine Designed for Milling V-8 Cylinder Blocks

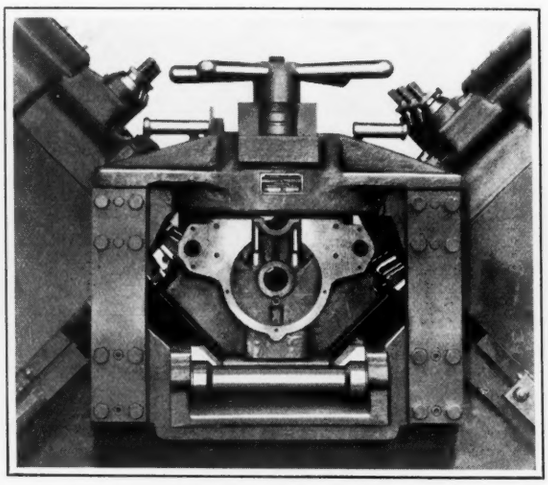


Fig. 2. The Fixture for the V-8 Cylinder Blocks is of All-steel Construction

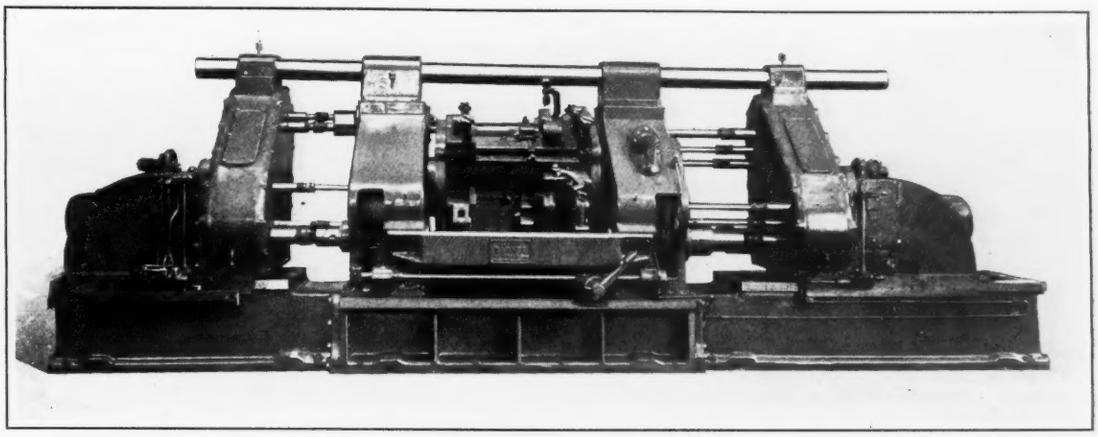


Fig. 1. Barnes Machine with Hydraulically Operated Sliding Heads at Opposite Ends of the Bed

Barnes Boring Machines with Self-Contained Sliding Heads

Two horizontal boring machines with self-contained hydraulically operated sliding head units are shown in the accompanying illustrations. Both machines were built by the W. F. & John Barnes Co., Rockford, Ill. The machine shown in Fig. 1 is of the double-end type, having two sliding head units and spindle heads arranged for drilling, hollow-milling, boring, and reaming operations on mower frames. The machine shown in Fig. 2 is of the three-way type, and is provided with spindle heads designed for boring tractor transmission cases. Although both machines are shown equipped for specific jobs, they could be fitted for other work by substituting different spindle heads.

The Barnes hydraulic self-contained, sliding-head units, with which both machines are equipped, consist of a saddle and a transmission casting which contains a high-pressure pump for slow feed movements of the head, a low-pressure pump for rapid traverse movements, an oil tank for the hydraulic system, control valves, and a motor. The motor not only drives all the hydraulic mechanism, including both pumps, but also drives the spindles.

The hydraulic cylinder of each sliding head is attached to the under side of the saddle, the piston ram being fastened to the base of the machine. For each sliding head, there is a plate with control dogs fastened to the base of the machine. These dogs are set in the proper positions to actuate the valves of the sliding heads as required. Each head can be operated independently, a condition that is advantageous in setting up the tools; in the normal operation of the machines, however, all heads are fed simultaneously.

When the operator depresses a button, an air valve is actuated, which starts the sliding heads on their cycles. The air control throws in the feed-lever on the hydraulic valve of each head. The machine then automatically passes through its entire cycle. In the case of the machine shown in Fig. 1, both heads first traverse rapidly forward to bring the spindles to the work, automatically trip to a slow feed for boring, trip a second time to a slower feed for facing, and final-

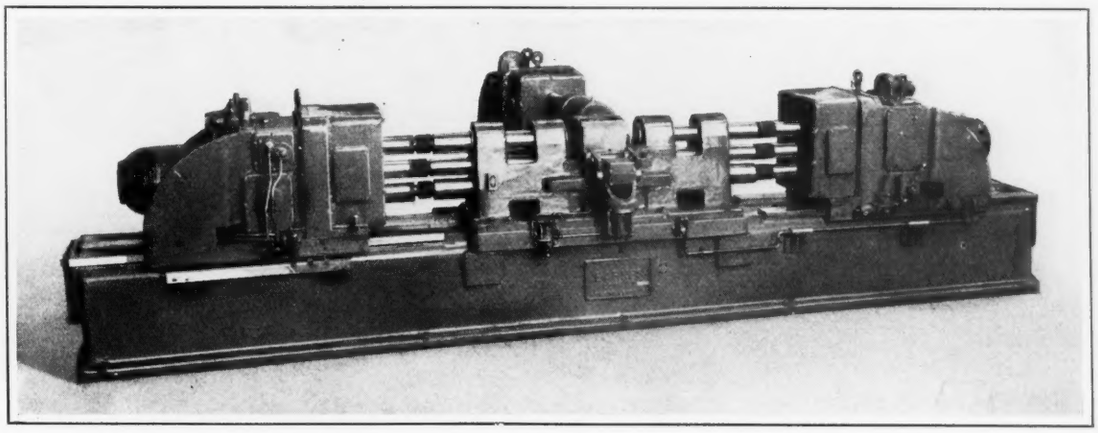


Fig. 2. Three-way Machine with Barnes Hydraulic Self-contained Sliding-head Units

ly return at the rapid traverse rate to the starting positions. This cycle could be easily changed to meet the needs of different jobs.

The machine shown in Fig. 2 passes through a somewhat similar cycle, simultaneously boring three holes in each end of the tractor transmission case and another at right angles in one side. Three cuts are taken successively on each hole: First, a single-point roughing cutter removes most of the stock; then a single-point tool takes a semi-finishing cut; and finally a double-point flat-blade boring cutter finishes the hole. The three cutters for each hole are mounted on one boring-bar so that the cuts are taken at one pass of the bar.

In the operation of the machine, all the roughing cutters must be out of the work before the semi-finish cutters start their cuts, and these cutters must be through before the finish cutters start. This provision guards against vibration or chatter of the cutters.

There is a clutch in the drive from the motor of each sliding-head unit to the corresponding spindle head, which can be disengaged in order to traverse the heads with the spindles at rest. All spindles run in Timken tapered roller bearings, and all bearings and gears in the multiple heads are automatically lubricated.

The work fixture of the machine shown in Fig. 1 consists of two trunnion supports, one at each end, which carry all the guide bushings for the boring-bars. The trunnion proper, which has four stations, is mounted on Timken bearings. It is indexed by a hand-crank on the right-hand trunnion support. The trunnion is accurately locked in each of the four indexed positions. Extending across the top of this machine and held by each trunnion support is a 6-inch over-arm or tie-bar. The multiple heads slide on this tie-bar. The machine has an over-all length of 24 feet, and weighs 55,500 pounds complete, including the motors.

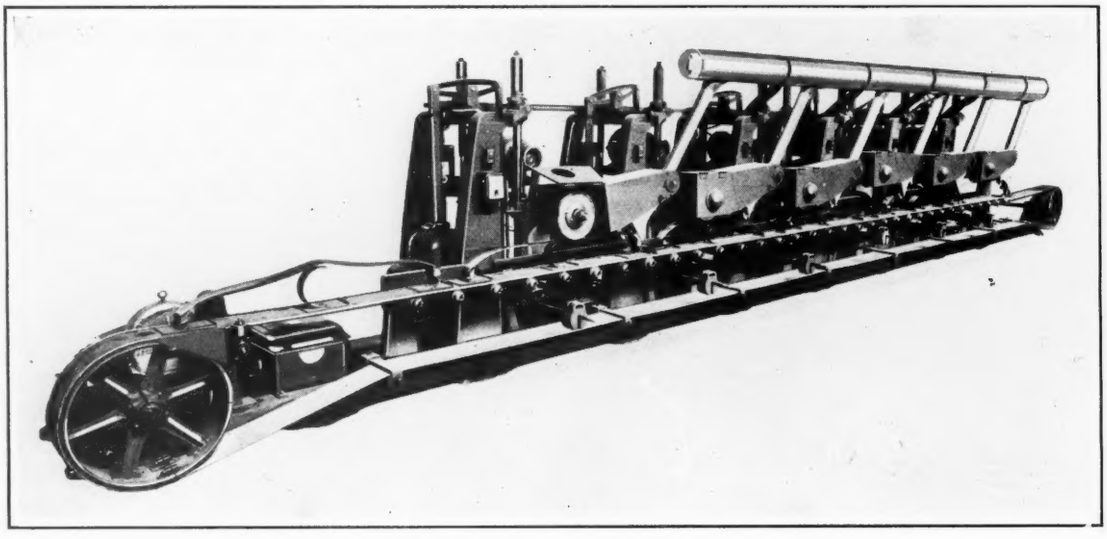
The work fixture of the machine shown in Fig. 2 is operated entirely by air, three cylinders being used to clamp the work in position. These cylinders are all controlled from the valve at the left of the operating position. This valve works like a small electrical control; when the handle is moved in one direction, all the cylinders are actuated to open the fixture, after which, when the work is in place, the handle is turned in the opposite direction, which admits air into the cylinders and clamps the work. There is no hand-clamping.

This machine has an approximate weight of 30,000 pounds, including the motors.

Excelsior Automatic Grinding and Polishing Machine

The straight-in-line automatic grinding and polishing machine here illustrated has been brought out by the Excelsior Tool & Machine Co., East St. Louis, Ill., for handling automobile bumpers. This machine, designated the No. 29, incorporates improvements over a model previously described in MACHINERY; the heads are spaced farther apart, the machine throughout is of heavier construction, double dust spouts reduce the dust hazard, and the capacity has been greatly increased. The wheels have a 12-inch rise.

Each unit is equipped with a 10-horsepower motor which drives the polishing-wheel spindle through grooved pulleys and V-belts. Weights prevent the wheels from bouncing up or down as the work passes by. A Reeves variable-speed transmission drives the belt conveyor.



Excelsior Straight-in-line Polishing Machine for Automobile Bumpers

The six-wheel machine shown occupies a floor space of 6 by 48 feet, and has an approximate weight of 25,000 pounds. A fourteen-wheel machine gives a production of from 1000 to 2000 bumpers per day, depending upon their size and shape.

Sykes 22-Foot Gear Generator

A Sykes gear generator that weighs 120 tons and handles gears up to 50 tons is the latest development of the Buffalo Division of the Farrel-Birmingham Co., Inc., Ansonia, Conn. This huge machine can cut gears up to 22 feet in diameter, 60 inches face width, and 6 inches circular pitch or 1/2 diametral pitch. The minimum tooth size for which the machine is intended is 6 diametral pitch.

This machine was built for the Youngstown Works of the United Engineering & Foundry Co., Pittsburgh, Pa. It is primarily adapted for cutting the herringbone gears used in the steel industry, but it is equally suitable for producing turbine reduction gears of sizes used in marine propulsion. In addition to gears of the large sizes referred to, pinions of relatively small diameter can be produced. Pinions as small as 8 inches pitch diameter can be cut with cutters 12 inches in diameter, and as small as 3 inches pitch diameter with cutters 18 inches in diameter. Pinions can be produced integral with shafts of any length on either side of the teeth and of any diameter up to 30 inches, the main spindle of the machine being bored to 30 1/4 inches.

This machine is an improvement over the 19-foot generator described in April, 1929, MACHINERY, page 565. The work-carrying mechanism is secured rigidly to the bed, while the cutter driving and controlling mechanism is mounted on a saddle that slides on ways on the main beds.

The indexing worm-wheel is 12 feet in diameter. It is used only during the cutting operation and rotates very slowly, several hours sometimes being required to make one revolution. Bolted to the indexing wheel is an auxiliary spur-gear ring which can be driven through a separate motor. Thus, when it is desired to test a wheel blank for truth or to turn the main spindle for setting-up purposes, the indexing mechanism can be disengaged, so as to avoid wear. In previous large Sykes machines, the indexing worm-wheel was used for quick rotation of the main spindle.

The main driving motor is mounted on the saddle that carries the cutter driving and controlling mechanism. This arrangement avoids long splined shafts and results in a smoother drive to the cutters. Any speed of cutter-saddle reciprocation is available from one to sixty strokes per minute. The generating feed mechanism is actuated from the main drive through a safety clutch that will slip and stop the machine in case the generating feed mechanism should require too much power. Four different speeds are available for the feed mechanism.

The machine is equipped to use either helical or straight-tooth cutters. Consequently, herringbone, single-helical, or straight-tooth spur gears can be produced. The two cutting tools operate alternately, so that the cutting is continuous. During the return stroke, each cutter is withdrawn from the work by means of a relief mechanism. The relief mechanism is of an improved type that insures silent operation. Another advantage is that the cutter housings are locked rigidly during the cutting stroke, thus permitting heavier cuts to be taken. The helical guides attached to the cutter-spindles are interchangeable.

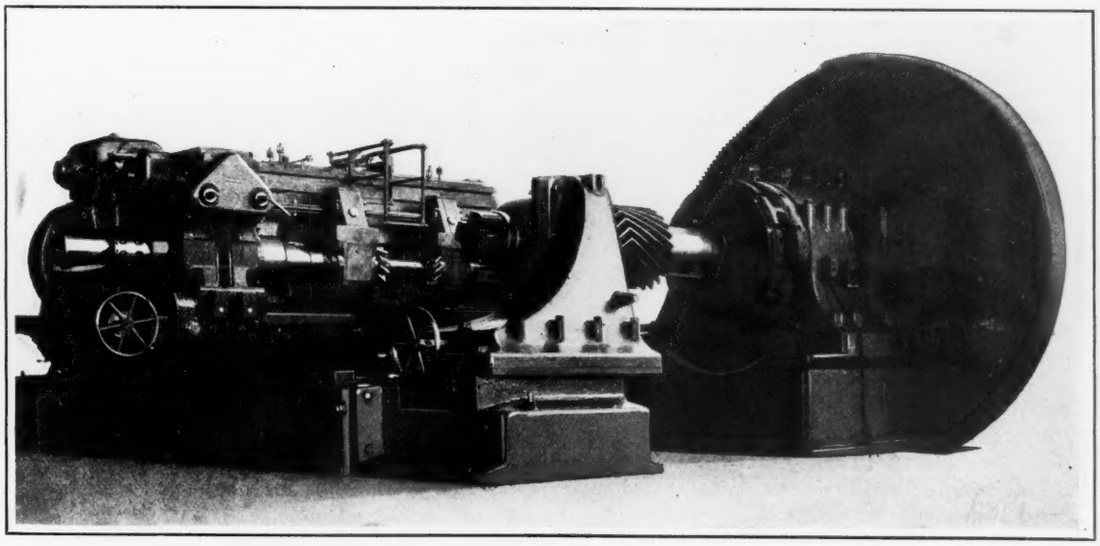


Fig. 1. Sykes Gear Generator for Gears up to 22 Feet in Diameter by 60 Inches Face Width

The stroke of the machine is adjustable from 0 to 32 inches. The position of the cutter-heads is also adjustable within a wide range. After an adjustment, the heads are locked to the reciprocating carriage by means of a differential mechanism. The main driving motor is of 40 horsepower capacity, while the motor for quickly operating the main spindle is of 10 horsepower rating. The auxiliary motor for the power traverse of the main spindle is of 5 horsepower capacity, and there is a fourth motor of 3 horsepower capacity that is used for driving the cutting coolant pump.

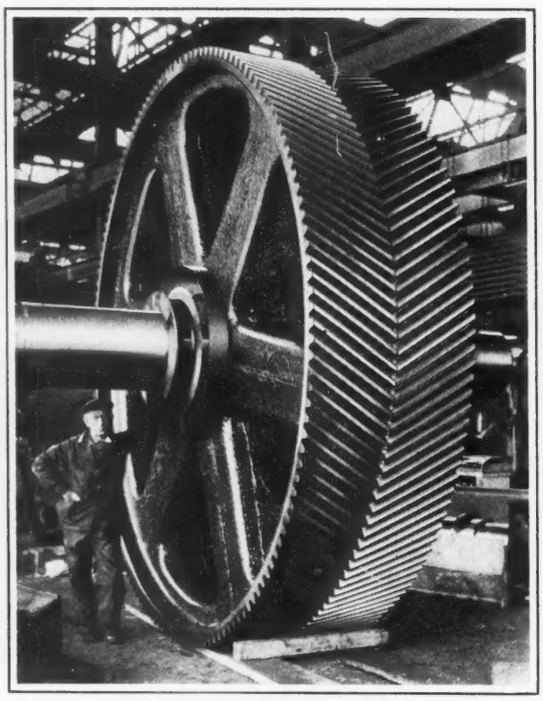


Fig. 2. Huge Continuous-tooth Herringbone Gear Cut in the Sykes 22-foot Generator

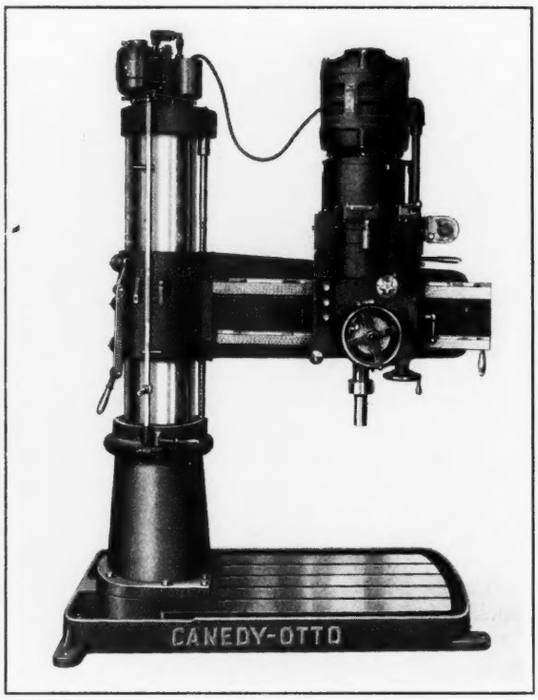


Fig. 1. Canedy-Otto Radial Drill with Spindle Driven Direct from Motor at High Speeds

Aluminum Welding Rod in Coils

Oxweld No. 14 drawn aluminum rod for welding sheet aluminum, and Oxweld No. 23 aluminum rod for welding cast and sheet aluminum or aluminum alloys, have been made available by the Linde Air Products Co., 30 E. 42nd St., New York City, in the form of 10-pound coils of 1/8-inch diameter rod. With these welding rods in coil form, waste from short ends is reduced. Also, under many conditions, the welding operator can handle a tightly wrapped coil more easily than a 36-inch straight length.

Canedy-Otto Motor-Spindle Radial Drilling Machines

Radial drilling machines of new design are being introduced on the market by the Canedy-Otto Mfg. Co., Chicago Heights, Ill., in 9- and 11-inch column sizes. These machines can be equipped with either 3- or 4-foot arms. One of the principal features of the machines is that the spindle is driven direct at high speeds, without gearing, by a four-speed motor with which it is centrally aligned. This arrangement permits the head to be of simple construction and provides for sensitive operation.

The drum control on the head enables the speeds to be changed instantaneously. Four speeds, in addition to those obtainable through the motor, are available on the 9-inch column machine through back-gearing, operated by means of a single lever control. These speeds may range from 85 to 1750 revolutions per minute or from 60 to 1200 revolutions per minute. This machine can also be supplied as a high-speed radial drilling machine without back-gears for operation at speeds of 900, 1200, 1800, and 3600 revolutions per minute. Fig. 2 shows a close-up view of the head on this machine.

The 11-inch column machine is equipped with the head shown in Fig. 1, which gives eight speeds through back-gearing, in addition to the four motor speeds. The total range may be from 28 to 1800 revolutions per minute or from 20 to 1200 revolutions per minute. This eight-speed

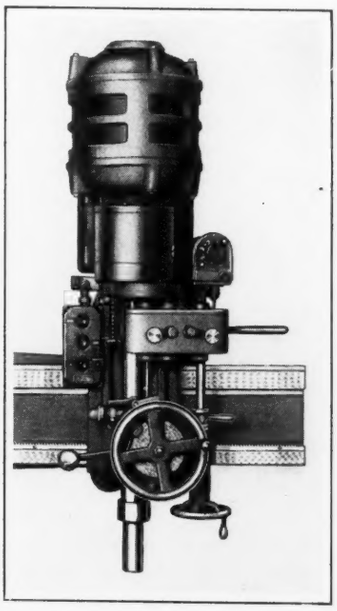


Fig. 2. Drill Head which Gives Four Speeds, in Addition to the Four Motor Speeds

head can also be provided on machines with 9- or 10 1/2-inch columns.

The push-button control on both machines provides for instant starting, reversing, or stopping. This control makes it possible to use the machines for tapping with as many as ten reversals per minute. If a machine is to be used more for tapping than for drilling, a special motor can be furnished that will enable as many as fifty reversals per minute to be made. The reversing speed is twice that of the forward speed.

Four feeds are available on the 9-inch column machine through the operation of a lever on a gear-box at the front of the head, while six feeds are available on the 11-inch column machine. In each case, a ratchet-feed clutch lever makes it possible to disengage the feed mechanism for hand-feed operation. A large graduated dial provides an accurate depth gage. There is an automatic trip-bar for self-feed operation.

The head saddle of both machines is carried on ball-bearing rollers which travel on a hardened and ground steel way. The column rotates on annular ball bearings and Timken roller bearings. On the 11-inch column machine, the arm is raised and lowered by means of an individual motor mounted on top of the column, as shown in Fig. 1. The 9-inch column machine can be similarly equipped or arranged for hand movement only of the arm. The net weight of the 9-inch column machine is about 2985 pounds, and that of the 11-inch column machine is 4425 pounds.

Barnes Drill Co.'s Single-Spindle Honing and Lapping Machine

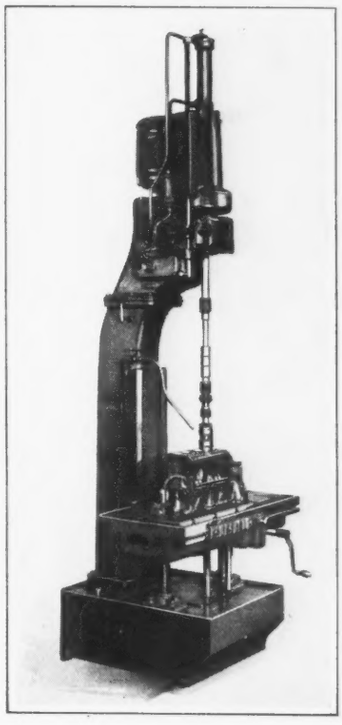
Holes of any size up to 4 inches in diameter can be honed or lapped in a single-spindle, single-speed honing and lapping machine recently designed by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill. This machine is believed to be the smallest hydraulically reciprocated equipment of its type on the market. Hones are used for all diameters from 3/4 to 4 inches, while laps can be used on smaller holes. Thus the machine is suitable for lapping small bushings and similar parts, as well as for honing automobile cylinders. It can therefore be used not only in production lines, but also for tool-room service.

The machine has a maximum stroke of 8 inches and a minimum stroke of about 1/2 inch. Short "stroking" can be performed at either end of the spindle travel for quickly removing any taper that may have been left by preceding operations. The machine is furnished with gears for any one speed of spindle rotation and with the hydraulic control adjusted for one rate of spindle feed or reciprocation. For honing cast iron, the recommended practice of the manufacturer is to rotate the hone at a peripheral speed of from 250 to 300 feet per minute and to use a stroke feed of about 50 lineal feet per minute. A telescopic sleeve extension on the nose of the spindle facilitates entering the hone into the work and removing it.

Various types of tables can be supplied. The indexing table illustrated is particularly suitable for honing cylinder blocks and similar work. A table mounted on the ways of the column and raised by means of a screw can be furnished or a fixed box table can be provided.

It will be noted that the head casting is separate from the column, a feature that permits columns of various heights to be used. Short columns can be supplied for bench or table installations.

A two-horsepower motor running at 1800 revolutions per minute is recommended for driving, the machine being designed for vertical application of the motor. The net weight of the machine without a motor, but equipped with a rectangular raising-screw table, is 840 pounds.



Machine for Lapping Holes up to 3/4 Inch and Honing Holes up to 4 Inches

Gairing Hollow-Mills

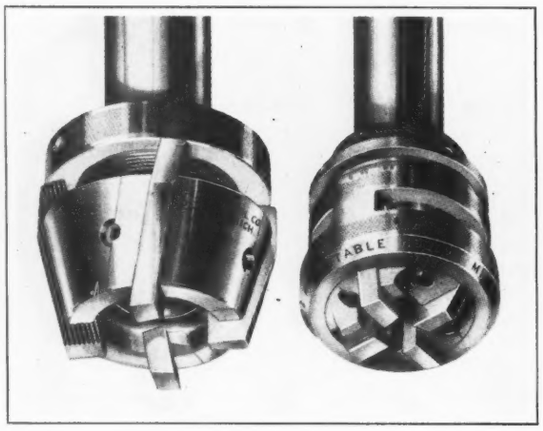
The latest addition to the line of end cutting tools made by the Gairing Tool Co., Detroit, Mich., is the Type J serrated-blade hollow-mill shown at the left in the illustration. This tool is designed to take light roughing and finishing cuts in hollow-milling and turning operations. The blades, which are replaceable, are set radially for machining brass, bronze, cast iron, etc., and at an angle, as shown, for cutting steel. The body can also be fitted with drills, reamers, or form blades.

Each serrated blade is anchored in position by engaging a corresponding serration in the body. A hardened and ground steel wedge supports the blade the entire length of the body, thus holding it rigidly. The blades can be quickly adjusted or released for replacement by loosening the lock-screw that holds the wedge. Adjustments can be made both radially and laterally, the locking or thrust collar on the threaded portion of the body being used to force the blades forward in their respective slots.

This hollow-mill is supplied with high-speed steel blades ground to size with the blades in contact with the bottom of the slots. An adjustment of 1/8 inch can be obtained by means of the adjusting nut, but the blades can be adjusted larger amounts by means of the serrations.

The Type H heavy-duty hollow-mill, shown at the right in the illustration, was designed to increase the efficiency of turning, facing, and shoulder-cutting operations. Adjustments of this hollow-mill are made by simply rotating the cone-shaped external nut which bears directly on the outer edge of the blades. A dial on the adjusting nut is graduated to thousandths of an inch to facilitate settings. This feature permits adjustments to larger or smaller diameters without regrinding of the blades.

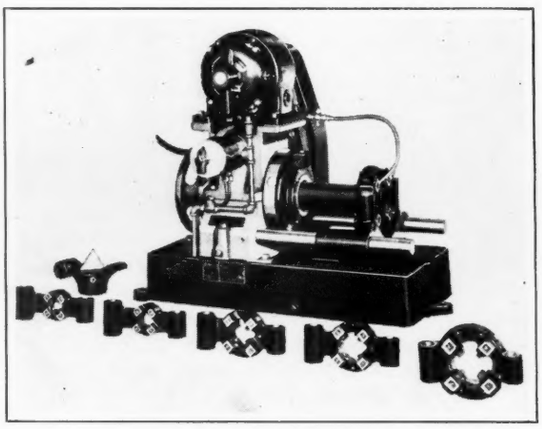
This hollow-mill is made sufficiently strong to suit the use of Stellite or cemented tungsten-carbide tools, although high-speed steel blades are standard. The body can be made for taking multiple cuts or it can be equipped with drills and reamers. Pilots can be inserted for facing and spot-facing operations. The blade adjustment on standard mills is 1/4 inch, but they can be adjusted 3/8 inch when used for taking medium or finishing cuts.



Gairing Hollow-mills for Light-duty and Heavy-duty Service, Respectively

Giant Roll Lathe—Correction

In a description published in May MACHINERY concerning a large roll lathe built by the United Engineering & Foundry Co., First National Bank Bldg., Pittsburgh, Pa., the statement was made "It is believed to be the largest roll lathe in the world as concerns capacity, power, and weight, but it occupies no more floor space than a small-sized roll lathe." Obviously this statement was wrong. What was intended to be said was that while the machine is believed to be the largest as concerns capacity, power, and weight, it was designed to occupy as little floor space as possible, and is as conveniently controlled as a small roll lathe.



Tom Thumb Pipe Machine which Handles Sizes from 1/4 Inch to 2 Inches

Tom Thumb Pipe Machine

The regular capacity of the No. 512 Tom Thumb portable pipe machine, which is being introduced to the trade by the Oster Mfg. Co., 2067 E. 61st Place, Cleveland, Ohio, is for pipe from 1/2 to 2 inches. However, the machine can be equipped for handling 1/4- and 3/8-inch pipe as well.

Solid die-heads are furnished for each pipe size. Practically no time is lost in changing the dies, because each head is merely held on two vertical studs of the carriage. For cutting-off operations, the die-head can be swung out of the way so as to provide clearance for the pipe. The ma-

chine is furnished with or without a cutting-off attachment.

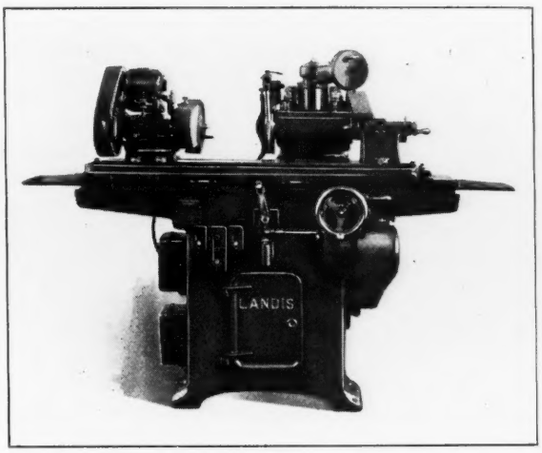
V-belts transmit the drive from the motor to a spiral Micarta pinion and thence to a spiral gear on a worm-shaft. The final drive to the spindle is through a triple-thread worm mounted on Timken bearings. There is a three-jaw scroll chuck on the front end of the spindle and a three-jaw centering chuck on the rear end. The rear chuck is operated through a handwheel.

Landis Motor-Driven Universal Grinding Machine

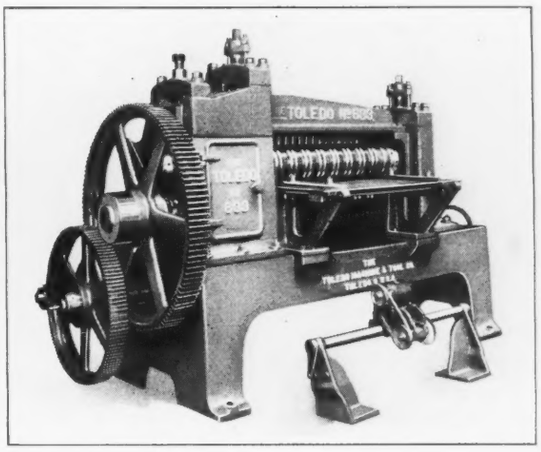
The 10- by 24-inch motor-driven universal grinding machine now being placed on the market by the Landis Tool Co., Waynesboro, Pa., is suitable for manufacturing a large variety of light parts in small lots for tool-room work and for use in technical colleges and schools. This machine has a 1/2-horsepower traverse-drive motor mounted within the bed; a 1/6-horsepower work-drive motor mounted on the headstock; and a 1-horsepower wheel-drive motor mounted on the wheel-base. In combination with a water reservoir, which is integral with the bed, these motor mountings make the machine entirely self-contained. All three motors are controlled from the front of the machine.

Three traverse speeds are available for the work-carriage through three-step cone pulleys. A lever at the front of the machine disengages the clutch when it is desired to traverse the carriage by hand. The standard equipment includes a 10- by 1/2- by 5-inch grinding wheel. The wheel-head can be swiveled on its slide for setting the wheel at various angles without affecting the direction of the feeding movement. A lower swivel can be turned for feeding the wheel in different directions. A plain wheel-feed mechanism is used.

The headstock drive motor is attached to a hinged plate which can be adjusted to maintain the proper belt tension. Six work speeds are available. A lever at the front of the head is depressed to keep the work from drifting when the motor has been stopped. The spindle can be rotated for live spindle grinding or locked for dead spindle grinding. It is also possible to swivel the upper portion of the head 90 degrees for face-grinding operations. The weight of the machine, without electrical equipment, is 3050 pounds.



Landis 10- by 24-inch Universal Grinding Machine for Light Manufacturing and Tool-room Use



Toledo Gang Slitter for Cutting Sheets of Indefinite Lengths into Various Numbers of Strips

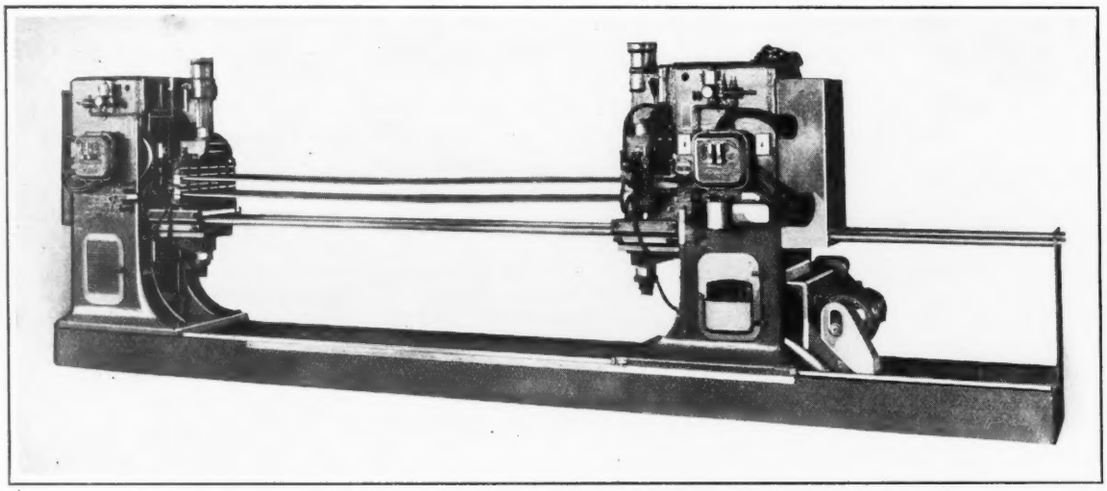
Toledo Gang Slitting Machine

The gang slitting machine here illustrated is designed to cut a sheet of indefinite length into any desired number of strips without camber and with a high degree of accuracy. This is a recent development of the Toledo Machine & Tool Co., Toledo, Ohio. This machine has a capacity for taking twenty-five cuts in steel of 0.025 inch thickness or a lesser number of cuts in heavier steel.

The maximum distance between the outer cutters is 36 inches. Strips of any width down to 1/2 inch can be cut.

The necessary adjustments for changing the width of the strips can be quickly made. There is provision for attaching a long table to the machine for holding the sheets while they are being fed to the cutters. The cutters revolve at 19.5 revolutions per minute, and the sheets travel through the cutters at the rate of approximately 46 feet per minute.

A special cutter-grinding attachment permits of sharpening the cutters without removing them from their shaft. The machine is driven by a 20-horsepower motor, which is geared direct. The total weight of the gang slitter is approximately 13,000 pounds.



Thomson-Gibb Special Heating Machine in which Fins are Rapidly Soldered on Tubes

Thomson-Gibb Electric Heating Machine

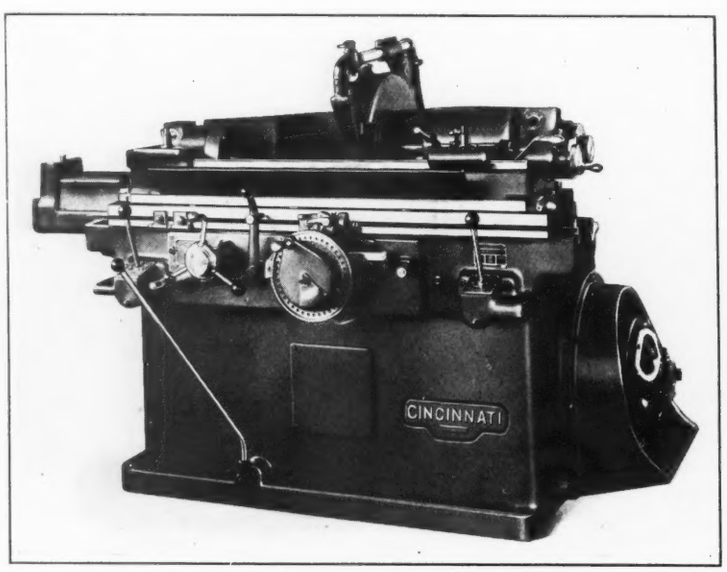
A special application of direct-controlled heating by the electric resistance method has been made in a machine recently developed by the Thomson-Gibb Electric Welding Co., Bay City, Mich., to facilitate a soldering operation on copper tubes. Each work assembly consists of from three to twelve copper tubes on which a large number of flanged fins must be thoroughly soldered. In operation, the tubes are covered with solder, the fins assembled, the soldering acid applied, the complete unit clamped in the machine, the current turned on and, in approximately one minute, the entire assembly is thoroughly soldered.

One unit of the machine is fixed on the base, while the other is adjustable a distance of 10 feet by power. Adjustable time relays give a definite heating period for the work in hand. Air cylinders are used for clamping the work.

This method of direct-controlled heating by electrical resistance can also be applied to other classes of work, such as heat-treating and heating for forging, bending, etc.

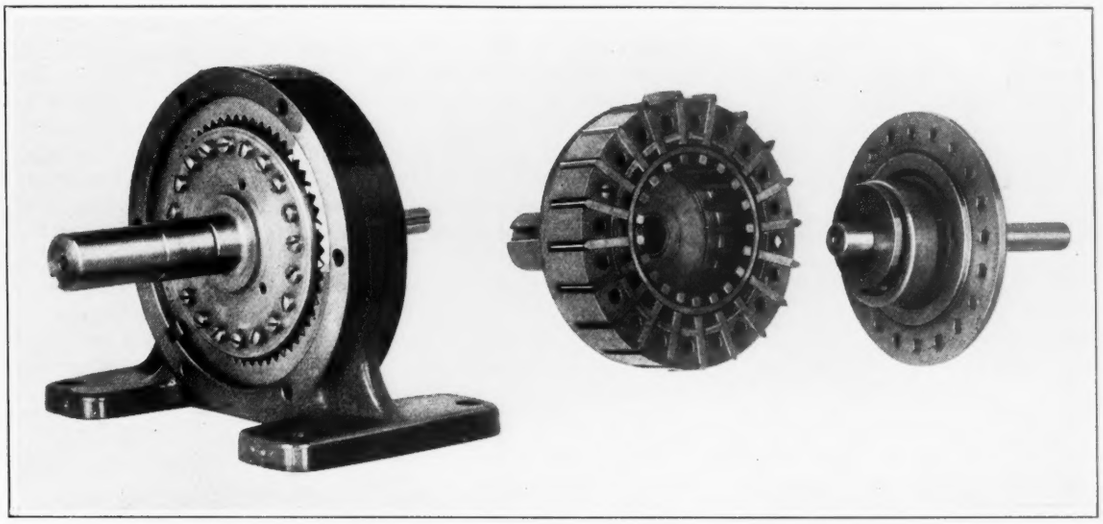
Cincinnati Saddle-Type Grinding Machines

A study of the operating conditions under which small center-type precision grinding machines are used led to the development of a new 6-inch saddle-type machine by Cincinnati Grinders, Incorporated, Cincinnati, Ohio. This machine has been designed with a view to permitting small-diameter work, properly supported, to be subjected to a grinding wheel load of relatively high horsepower, with a corresponding increase in production. The aim has been to eliminate the need of buying machines with greater capacity than required in order to obtain adequate horsepower for grinding the work. This 6-inch machine finds its greatest application in manufacturing departments.



Cincinnati Saddle-type Grinding Machine of Improved Design

To meet the demand for saddle-type grinding machines with an increased distance between centers and a greater swing corresponding to the horsepower rating, a saddle-type machine has also been brought out with a 10-inch swing and a 10-horsepower motor for the grinding wheel.



(Left) Heliocentric Speed Reducer; (Center) Slow-speed Element; (Right) High-speed Element

This machine is built with a distance of either 18 or 36 inches between centers, while the center distance of the 6-inch machine may be 18 or 30 inches.

This new line of saddle-type machines contains a number of improvements over previous models, including a long hand-lever placed conveniently for the operator's left hand, which starts and stops the table traverse, the rotation of the work, and the flow of cutter coolant. The motor mounting has been improved by adopting a shoe-type bracket that permits the use of standard motors having feet. This bracket is so arranged that the motor can be swiveled quickly out of position to facilitate changing the Texrope belts. Spiral gearing has been substituted in the headstock for worm-gearing.

Heliocentric Speed Reducers

Heliocentric speed reducing units are now manufactured by the Universal Gear Corporation, 19th St. and Martindale Ave., Indianapolis, Ind., in capacities from fractional to 150 horsepower. Single-stage reducers are available in ratios from 20 to 1 up to 80 to 1, while multiple-stage reducers can be obtained in ratios up to 1,000,000 to 1. Straight-line, vertical, offset, and right-angle drives can be provided.

These speed reducers operate on the principle that has been previously described in the technical press. They consist primarily of a stationary unit, a high-speed rotating unit, and a slow-speed rotating unit. The stationary unit is composed of the case, end covers, and an internal ring-shaped rack that is doweled to the case.

The high-speed rotating element consists of the input shaft, which is equipped with one eccentric for reducers of 5 horsepower capacity or less, and with two eccentrics, 180 degrees apart, for units of over 5 horsepower rating. These eccentrics actuate plungers of the slow-speed unit through ball or roller bearings. The high-speed element is mounted completely within the slow-speed element, except for the shaft projection. It rotates in the same direction.

The slow-speed element consists of the output shaft, a flange, and a plunger-holder. The plungers are reciprocated radially in slots in the holder, the eccentric pushing them outward through the rollers. The plungers are retracted by means of a ring.

As the plungers are pushed radially outward, they slide forward tangentially on the 45-degree slope of the teeth on the internal rack. In so doing, they carry the plunger-holder forward and thus rotate the slow-speed element. On reducers of 5 horsepower or greater, the two eccentrics operate two sets of plungers.

Continuous Bar-Stock Trademarking Machine

A continuous inscription is marked on bar stock at a speed of 110 to 140 feet per minute by

Noble & Westbrook Machine for Trademarking Bar Stock

means of the machine illustrated, which was recently built by the Noble & Westbrook Mfg. Co., Hartford, Conn. This method of marking is particularly suitable for stock to be used in making screw machine products; it constitutes a convenient means of insuring a trademark on each piece.

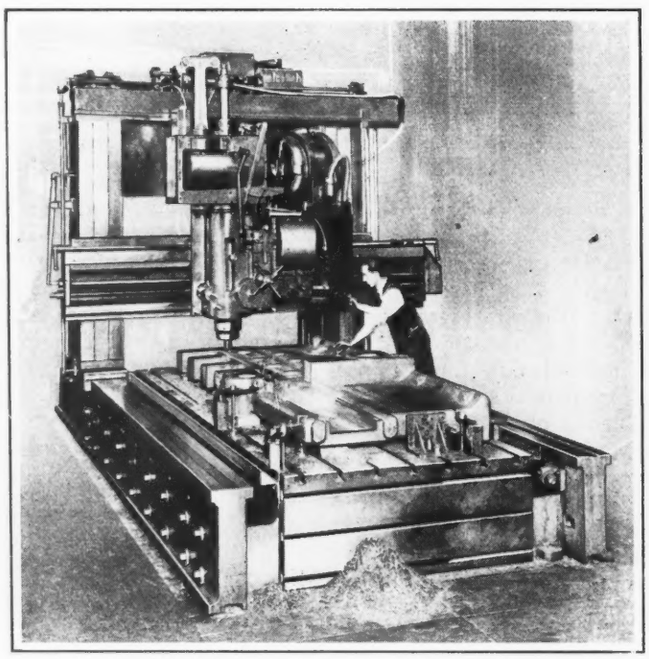
The machine was primarily designed for the continuous trademarking of square stock in sizes from 1/4 to 1 inch, but hexagonal or round stock can be marked as readily. The machine is equipped with a hardened steel feed-roll which is driven through worm-gearing. Two pulleys of different sizes and a V-belt drive from the motor give the required speeds. The marks are rolled on the bar stock by means of a steel die.

The machine can also be adapted for ribbon stock made of brass or steel. It has a weight of about 350 pounds.

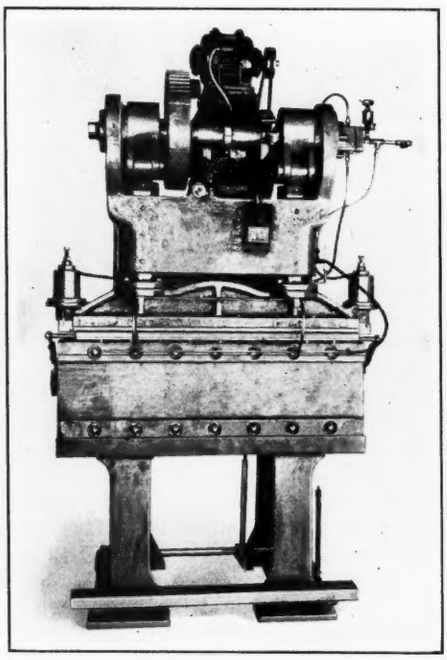
Norin Seventy-Ton Press

A power press of unusual construction, as shown in the accompanying illustration, was recently built by the Norin Engineering Co., 355 Union Park Court, Chicago, Ill., for the Edw. Katzinger Co. of the same city. This machine has a cross-head that is actuated by two plungers, connected to the crankshaft by links and crank-levers. The arrangement of links and levers has been designed to give a uniform operating speed to the cross-head and, therefore, a uniform pressure stroke.

The press has a maximum capacity of 70 tons and operates at a speed of forty cycles per minute. A 1 1/2-horsepower motor supplies the power, the energy being stored in a flywheel until a clutch connects the drive with the crankshaft. This clutch is arranged to release at a predetermined load. The crankshaft revolves 145 degrees only and then returns to the starting position. If the press should be operated without any work in



Milling Machine with Stationary Table and Spindle Head that Moves Vertically, Crosswise, and Lengthwise



Norin Power Press, the Tonnage of which is Adjustable up to 70 Tons

Sleeper & Hartley Universal Milling Machine

A vertical-spindle milling machine consisting of a milling head mounted on a cross-rail and housings that travel along a stationary work-table has recently been built by Sleeper & Hartley, Inc., Worcester, Mass. Milling operations can be performed on the sides, top, and ends of work without changing the set-up, and holes can be bored, drilled, or tapped by power in the vertical plane. The small amount of space required for operation, in comparison with the work capacity, will readily be noted from the illustration.

The distance between the housings is 6 feet 2 inches, while the table is 12 feet long by 5 feet 2 inches wide. The machine occupies a floor space of 20 by 13 feet, and weighs 45,000 pounds.

The vertical milling spindle is driven by a four-speed 10-horsepower motor, mounted on the spindle head. By means of a back-gear arrangement, eight spindle speeds can be obtained. A separate 7-horsepower motor on top of the cross-tie provides power for all movements of the head. The housings are operated by a longitudinal screw.

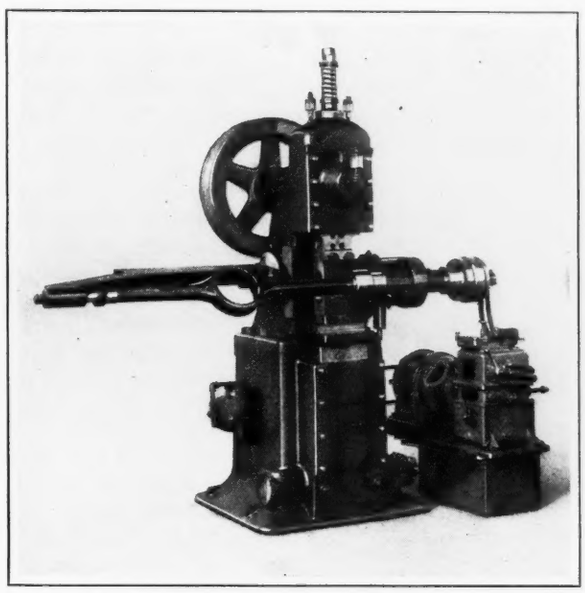
place, the release clutch would be automatically disengaged when the crankshaft had turned 145 degrees. The tonnage may be adjusted from zero to the full capacity of the press.

Langelier Hammering Machine

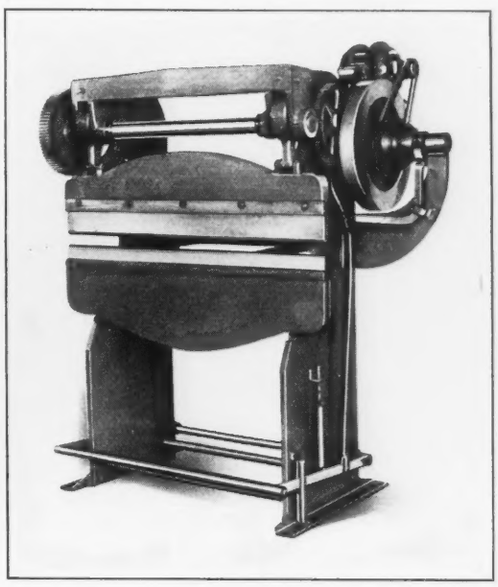
The Langelier Mfg. Co., Providence, R. I., has just designed and built a battery of machines for forming automobile rear-axle housings after the two pressed-steel halves have been welded together. One of these machines is shown in the illustration. It is used for hammering the section at the end of the housing to which the spring perch is attached. After the welding operation, the parts are over-size and out of round; the hammering reduces the diameter of the tube, increases the wall thickness, and makes the housing round and to size within 0.002 inch.

The operating principle of this machine is similar to swaging. The main spindle, driven by a flywheel, carries six rolls that strike a roll in the oscillating plunger to which the upper die is attached. The spindle is driven through V-belts at the rate of 300 revolutions per minute, with the result that 1800 blows are struck per minute on the work.

The lower die is operated through a toggle joint by a hydraulic cylinder. Pressure is built up in this cylinder by a variable-delivery high-pressure pump. The rotating mechanism is equipped with an air-operated collet-type chuck and an air-operated tailstock. The weight of the machine is about 4 tons.



Langelier Hammering Machine Built for Forming Rear-axle Housings



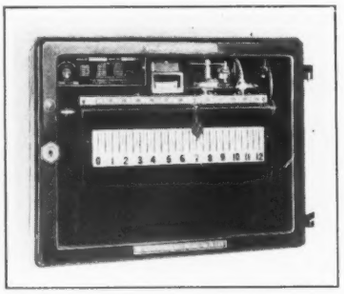
Small Press Brake which Exerts a Pressure of 14 Tons

Chicago Steel Forming Press

A small press brake which is powered by a 3/4-horsepower motor and yet produces a pressure of 14 tons has been developed by the Dreis & Krump Mfg. Co., 74th St. and Loomis Blvd., Chicago, Ill. This machine is adapted for rapidly forming sheet-metal sections such as are used in the manufacture of stoves, refrigerators, cabinets, metal furniture, etc. The die-holders are standard and will accommodate the same dies as large press brakes.

The machine is of steel construction throughout, including the bull gear and pinions. The bed is constructed of two plates, which are spaced 3/4 inch apart so as to permit the punchings to fall through to the floor. A single-plate friction clutch is built integral with the flywheel and operated by means of a foot-treadle. A brake works automatically with the clutch. By releasing the treadle, the ram can be stopped at any point on the up or down stroke. The motor is mounted on an adjustable hinged bracket and drives the flywheel through V-belts. Adjustments to suit dies of various heights can be made by raising or lowering the bed through large set-screws at the ends of the machine.

Some of the specifications of this machine are as follows: Length between housings, 37 inches; length of bed and ram, 50 inches; width of gap in housings, 6 inches; number of strokes per minute, 40; and weight of machine, 2100 pounds.



Brown Indicating Potentiometer with Self-balancing Feature

Brown Self-Balancing Indicating Potentiometer

An indicating potentiometer that balances itself is the latest addition to the line of the Brown Instrument Co., 4485 Wayne Ave., Philadelphia, Pa. In addition to this feature, the instrument has an unusually long (40-inch) slide wire, a secondary pointer that definitely fixes the size of step in moving the slide wire contact, a positive spiral shaft drive, a non-slip clutch, and an interchangeable case for universal mounting. The mechanism can be swung out of the case for inspection without interfering with its operation. Another feature is automatic thermal equalization between the cold junction terminals and the compensation coil.

As a pyrometer, this instrument can be supplied for any range from 0 to 100 degrees F. up to from 0 to 3000 degrees F., and for almost any span between these ranges. Models for automatically controlling temperatures, as well as for indicating, can also be furnished.

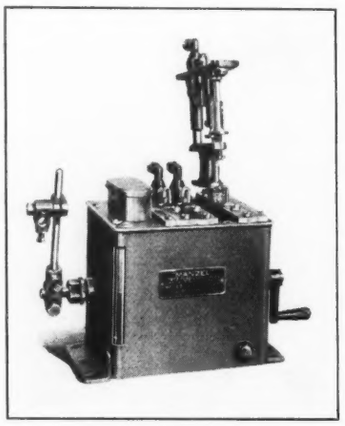
Manzel Force-Feed Lubricator

A Model 25 force-feed lubricator has recently been developed by the Manzel Bros. Co., 309-319 Babcock St., Buffalo, N. Y., for automatically lubricating the bearings of machine tools and other equipment. This lubricator, as will be seen from the illustration, consists of a tank in which are placed a number of individual pumping units. Each of the units comprises a small double-plunger pump which is independently adjustable for supplying just the amount of oil required by the bearing. There is an independent feed-line to each point to be lubricated.

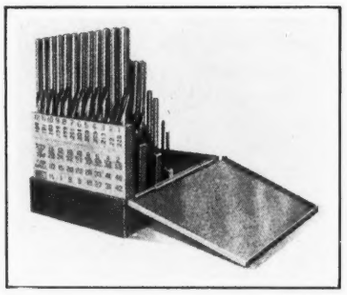
The length of the oil-pipes, viscosity of the oil, temperatures, or pressure on the bearings are said to have no effect on the operation of this lubricator. After the reservoir has been filled with oil and the feeds have been set to supply the proper amount to each point, no further attention is required except to replenish the oil when necessary.

A feature of the lubricator is the accessibility of the working parts; any pumping unit can be taken out of the reservoir for examination or repairs without stopping the lubricator or the equipment on which it is installed. The illustration shows one of the units lifted out.

These lubricators can be supplied in various sizes and styles to suit practically every type of machine. They can be furnished with from one to thirty feeds, with either a rotary or ratchet drive, with different sizes of reservoirs, and with various fastening arrangements. For high-speed machines requiring the delivery of very small amounts of oil to some bearings, they can be supplied with special drives.



Manzel Lubricator with One Unit Lifted out



Index Container for Drill Sets, which Enables any Size Drill to be Readily Located

Union Drill Sets in Index Containers

Two sets of drills are being placed on the market in Huot index containers by the Union Twist Drill Co., Athol, Mass. In these containers, the panels that hold the drills have numerals marked on them, so that any size drill can be readily found. As will be seen from the illustration, the drill sizes, decimal equivalents, and tap sizes are marked plainly. The panels are hinged so they can be folded into the box to permit stowing the container into a work-bench drawer or tool kit. The holes in the panels are individually drilled.

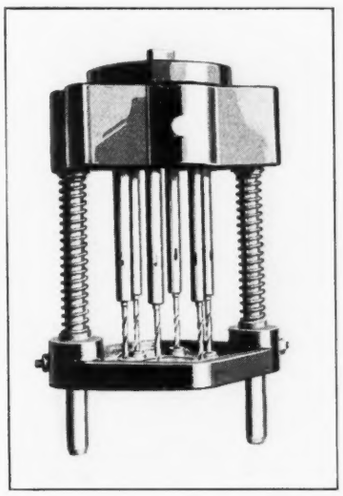
The No. 118 drill set includes carbon-steel jobbers' length drills from 1/16 to 1/2 inch, varying by sixty-fourths of an inch, and the No. 119 includes carbon-steel wire-gage drills from No. 1 to No. 60. The container for the No. 118 set is 4 inches wide, 7 inches long, and 1 3/4 inches deep, while the container for the No. 119 set is 3 1/4 inches wide, 4 1/2 inches long, and 1 inch deep.

Ace Chain-Driven Drill Heads

Multiple-spindle drill heads which differ from conventional types in that the spindles are driven by sprockets and chains are manufactured by A. H. Pearson, 7 E. Grand Ave., Detroit, Mich. The driving shaft of the head illustrated is provided with three sprockets and

one sprocket is mounted on each of the six driven spindles. Power is transmitted from each of the driving-shaft sprockets to the sprockets on two of the driven spindles.

One of the principal advantages claimed for the construction is the low load placed on the chains and sprockets. In the case of the drill head shown, which is designed for driving 25/64-inch drills at 1200 revolutions per minute, the load per chain is only 47 pounds, whereas the breaking point rating of the chain manufacturer is 2900 pounds. Another advantage of

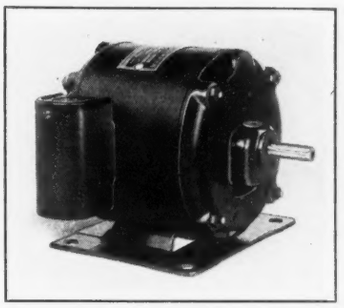


Multiple-spindle Drill Head with the Spindles Driven by Chains

this drill-head design is a wide distribution of the load over the sprocket teeth, approximately one-third of the teeth on each sprocket being constantly engaged with the corresponding chain. Low over-all height and a new type of oil seal are other features.

Wagner Split-Phase Motors

Two split-phase motors—a Model 44RB which is available in 1/30- and 1/20-horsepower sizes, and a Model 56 RB which is made in 1/8-, 1/6- and 1/4-horsepower sizes—are being placed on the market by the



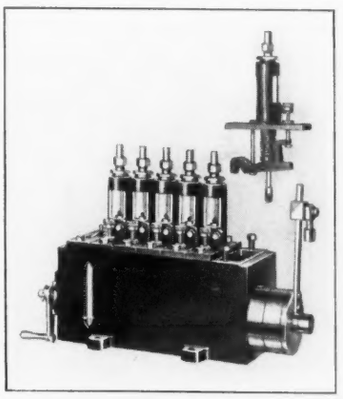
Wagner Split-phase Motor Made in 1/30 and 1/20 Horsepower Sizes

Wagner Electric Corporation, 6467 Plymouth Ave., St. Louis, Mo. These motors are equipped with drip-proof end-plates and are arranged for wool-yarn lubrication. They are supplied with a conduit box that is adjustable into four positions. The smaller model has a redesigned switching mechanism. Quiet, vibrationless, and cool operation are advantages claimed.

Bowser Force-Feed Lubricator

A force-feed lubricator which is equipped with liquid-filled sight glasses is being introduced on the market by S. F. Bowser & Co., Inc., Fort Wayne, Ind. This lubricator, which is shown in the accompanying illustration, is known as Fig. 451. Pumping units deliver the lubricant to the desired points.

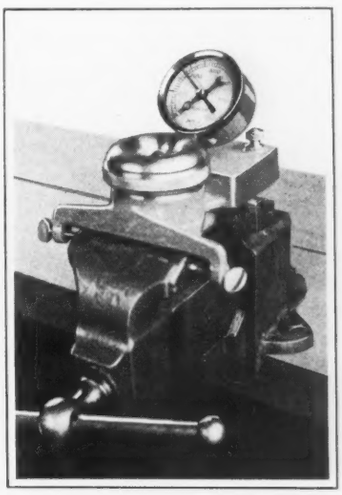
Any number of pumping units



Bowser Force-feed Lubricator with Sight Glasses

can be provided to suit requirements. Each unit serves the dual purpose of drawing oil from the reservoir and of forcing it in a straight vertical path through the sight glass to the point of lubrication at the end of the feed-line. Each unit is individually adjustable and can be removed while the lubricator is in operation.

Refilling the sight glass is a simple operation, a standard fitting permitting the injection of lubricant by means of a grease gun. Any type of driving mechanism can be supplied for this equipment.



Portable Tester for Sheet Metal up to 1/16 Inch Thick

Portable Sheet-Metal Tester

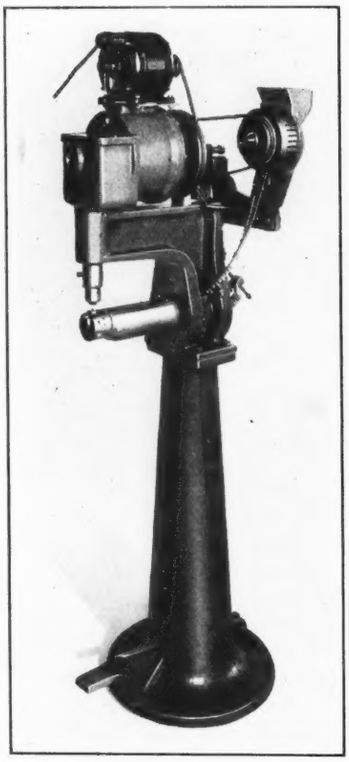
A portable device for determining the drawing qualities of sheet metal has been developed by the Detroit Testing Machine Co., 5137 Trumbull Ave., Detroit, Mich. This device is intended for use especially in stamping shops or wherever conditions do not warrant laboratory equipment. This Model V tester is hydraulically operated and embodies the same hydraulic clamping arrangement as the larger motor-driven machine described in September, 1931, MACHINERY, page 76. The clamping pressure is always in proportion to the load applied in making the test.

To make a test, the operator places the instrument in a vise as illustrated, inserts a specimen, and screws the cap on lightly. He then closes the vise to apply pressure hydraulically on a round punch or ball. The punch is forced through the material until a crack appears. The depth of penetration is then measured with a depth gage that is provided with the device. The load applied is read directly from the gage of the instrument. Material up to 1/16 inch in thickness can be tested.

Norin Riveter with Automatic Rivet Feed

A mechanical riveter equipped with an automatic device for feeding the rivets is being introduced to the trade by the Norin Engineering Co., 355 Union Park Court, Chicago, Ill. The rivets are fed from a hopper to a chûte which leads to a stake inserted in the riveter frame. On this stake, the rivets are moved step by step until they are inserted into holding fingers directly under the riveting dies. The rivet shank projects above the fingers and locates the work.

The machine as illustrated is capable of driving 5/32-inch diameter iron rivets. The tonnage of the machine can be adjusted by means of a screw to suit different jobs. The riveting dies stop on the work when the pressure for which the mechanism is adjusted has been developed, and then the dies return automatically. A 1/4-horsepower motor drives both the riveting mechanism and the automatic feed.



Norin Riveter with Automatic Device for Feeding the Rivets

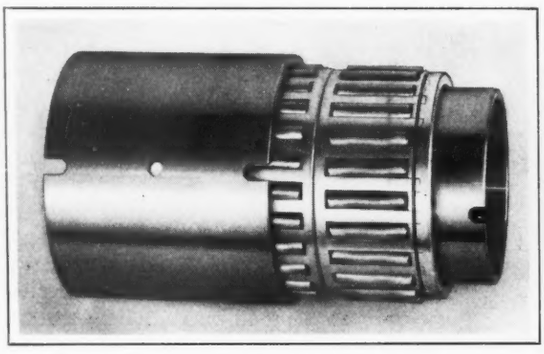
Bantam Roller Bearing with Two Cages

A roller bearing with two cages, one of which has twenty-three rollers and the other twenty-four, is being placed on the market by the Bantam Ball Bearing Co., South Bend, Ind. This type of roller is used on many types of machines, but it is particularly suitable for the plate cylinders and impression cylinders of newspaper printing presses, because of the increased speeds which it makes possible. The different numbers of rollers in the two cages give a "hunting tooth" effect that tends to eliminate the synchronized vibration of the cylinders at high speed. Each cage is entirely independent of the other.

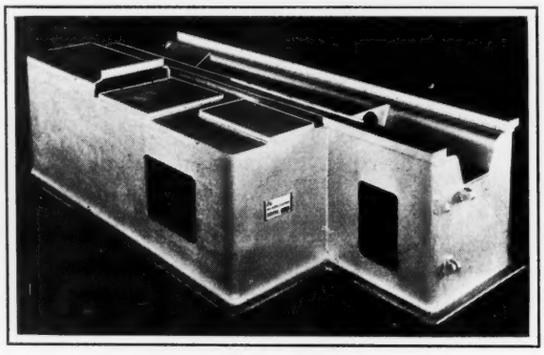
The rollers and races are given a lapped finish, so as to reduce wear. Both the rollers and races are made of a high-carbon, high-chromium, special bearing steel. This type of bearing can be made for use in a limited space, rollers 1/2 inch in diameter being commonly used with races having a wall thickness of only 1/4 inch.

Austin "Weldings"

Welded steel structures, such as machine bases and other parts, can now be furnished by a jobbing "weldery" recently established in Cleveland, Ohio, by the Austin Co. It is pointed out by the manufacturer that "weldings" are especially applicable to new products and models. Mention is made that one machine tool builder saved over 35 per cent in the cost of important parts for a special machine by making those parts from welded steel. In building a large polishing machine, 40 per cent was saved in the cost of the base by using a welded structure.



Bantam Roller Bearing with Two Cages Having Different Numbers of Rollers

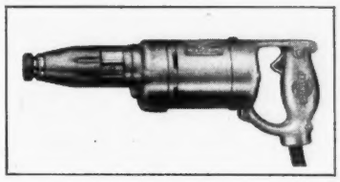


Welded Steel Machine Base Made by the Austin Co. Welding Division

Stanley Portable Electric Screwdrivers

The Stanley Electric Tool Co., New Britain, Conn., recently brought out a portable electric screwdriver with an adjustable-tension clutch, as described in April MACHINERY, page 637. Two larger screwdrivers with the same feature are now being introduced on the market by the concern. They are of the construction illustrated.

The Type No. 31 tool drives up to No. 12, 2-inch screws in hard wood, with the proper size lead holes provided. This screwdriver has an over-all length of 14 3/8 inches, a full-load speed of 235 revolutions per minute, and a weight of 8 pounds. The Type No. 32 screwdriver will drive up to No. 16, 3 1/4-inch screws in hard wood, and lag screws up to 5/16 inch by 4 inches. This tool



Electric Screwdriver with Adjustable-tension Clutch

is 15 3/4 inches long, has a full-load speed of 275 revolutions per minute, and weighs 9 pounds. Both types can be used for tightening nuts if equipped with socket wrenches.

As the adjustable-tension clutch releases at the pressure for which it has been set, the sinking of screws too deep into the wood, marring of work surfaces, overloading of the motor, stripping of threads, and damaging of screw slots are eliminated.

Esterline-Angus Graphic Recording Instruments

Graphic recording instruments or meters of improved design have been placed on the market by the Esterline-Angus Co., Indianapolis, Ind., for a large number of purposes, twenty-two different kinds of instruments being included in the line. Of particular interest to metal-working and machine-building plants are the instruments for determining the motor capacities required for machine tools; for recording the productivity of departments or machines; for making time studies of operations; and for checking power consumption.

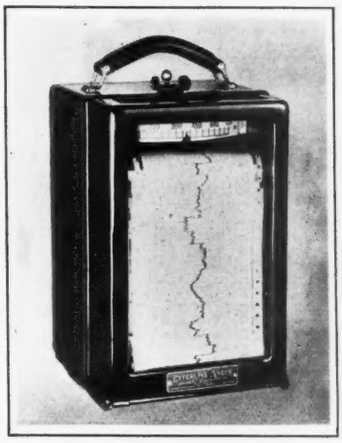


Fig. 1. Portable Graphic Meter for Tests on Machines

In electrically driven plants, the power load bears a definite relation to the productive work being done by the machine or department. Therefore, with one of these recording instruments in the power line, any loss in productive work is immediately shown. One of the important advantages obtained by using graphic instruments for studying machine operations is that the presence of an observer is not required. The instruments show the time consumed for each successive operation made by a machine, as well as the time between operations, and the time necessary for removing and replacing the work. The instruments also give valuable information concerning the power requirements of tools and desired frequency of grinding them, as well as information concerning delays due to causes that might be removed. The records are in ink and can readily be filed for reference.

Fig. 2. Twin Graphic Meter for Switchboard Installation

Fig. 1 shows a portable graphic meter which may be conveniently taken to machines for tests, while Fig. 2 shows a twin meter intended for permanent installation on a panel.

Thor 1/4- and 1/2-Inch Electric Drills

The Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., has brought out two

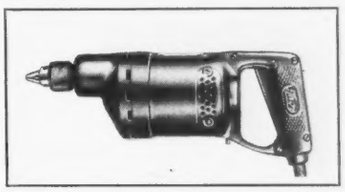


Fig. 1. Thor 1/4-inch Universal Electric Drill

new universal drills, a USA 1/4-inch size with a grip switch, shown in Fig. 1, and a URA 1/2-inch size with a side switch, illustrated in Fig. 2. The USA drill has a speed of 2500 revolutions per minute and weighs 8 pounds, while the 1/2-inch size runs at a speed of 500 revolutions per minute and weighs 14 1/2 pounds.

The armature shaft of these drills is made with the pinions milled directly on it to eliminate vibration. The armature core construction is of the open straight-slot type, which permits separate form-wound coils to be laid in the slots without first being flattened. The commutator is an independent unit; it is balanced and tested at 1100 volts before being assembled on the shaft.

The switch is of the double-pole type, breaking both sides of

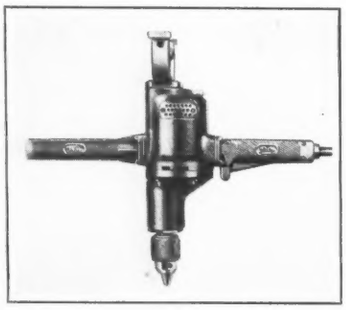


Fig. 2. Thor Universal Drill of 1/2-inch Capacity

the line at the same time and thereby disconnecting the current from the line to the motor. The switch on the USA drill is operated by a long lever. This switch is so arranged that it can be changed to either a safety-first or positive switch by pressing a lock-button on the handle.

Stanley "Flexible-Rigid" Steel Rules

Two steel rules of the "push-pull" type, with a blade that can be used rigidly or bent to suit the object being measured, are being placed on the market by the Stanley Rule & Level Plant, New Britain, Conn., in the design illustrated. The "Four Square" rule is in a steel case, 2 inches in diameter, which has a satin chromium-plated finish. It has a blade 1/2 inch wide. The "Defiance" rule is in a nickel-plated steel case, 2 1/8 inches in diameter, and has a blade 5/8 inch wide.

The blade of both rules is 6 feet long. It is graduated in inches and in sixteenths of an inch. A hook on the outer end of the blade permits taking measurements beyond arm's length.

"TonWate" Swivel Caster

A truck caster in which a flexible unit replaces the common king bolt is now being produced by the Divine Bros. Co., Utica, N. Y. This "TonWate" caster is of a simple two-piece design as illustrated. It is constructed throughout of heat-treated steel forgings, chrome-nickel steel balls and Hyatt roller bearings.

From Fig. 2 it will be seen that the rigid king pin is replaced by a flexible joint consisting of a ball *B* seated on the hardened cup of a Dardelet self-locking safety set-screw. The raceways are held together by splitting them vertically instead of horizontally, as indicated at *A* and *C*. With this balanced assembly, the load is distributed on center and annular balls, approximately two-thirds of the load being on the former and one-third on the latter.

Fig. 1. Truck Caster with Flexible Connection

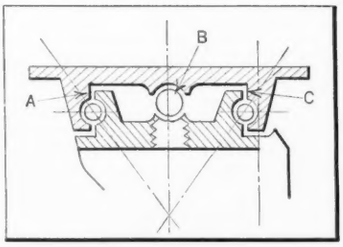


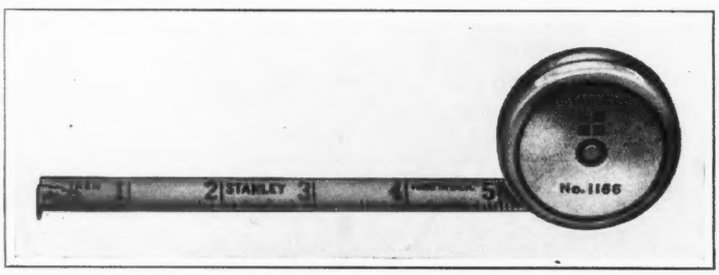
Fig. 2. Diagram of the Flexible Caster Unit

The axle of the caster rides on a Hyatt automotive-type roller bearing. The main load bearing and the swivel bearings operate in a reservoir of lubricant. The axle is also protected by a positive lubricating method. Hub guards keep out dirt, grit, or water and also prevent strings or cord from winding around the axle and binding the wheel. This caster is made in a wide range of sizes, with steel and canvas-cushion wheels.

McCrosky Improved Turret Toolposts

The turret toolposts manufactured by the McCrosky Tool Corporation, Meadville, Pa., have been redesigned to incorporate several important improvements. The fundamental feature of the indexing mechanism remains the same, there being a corrugated bearing surface on the under side of the turret body which meshes with corrugations on the stationary base of the turret column, providing twelve indexing positions.

One of the new features is the provision on the stem of the turret column of a hardened steel sleeve having twelve vertical grooves. These grooves are in axial relation to the twelve indexing positions. In the hole of the turret body are two spring plungers diametrically opposite each other, which engage the grooves of this sleeve. The ratchet effect produced by these parts is an aid to rapid indexing;



Steel Rule of the "Push-pull" Type Made by the Stanley Rule & Level Plant

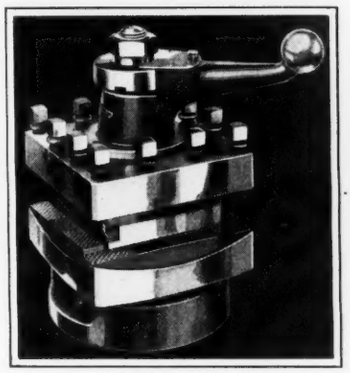


Fig. 1. McCrosky Turret Toolpost of Improved Design

the distinct click that occurs as the plungers engage the grooves tells the operator when the corrugations of the body are in true position for meshing with the corrugations of the column base.

The clamping handle is now fitted with a spring plunger that rides against a cam attached to the top of the turret column. This cam has a right-angle recess. When the handle is in the closed position, the plunger presses against the recess and locks the turret body rigidly.

When the operator wishes to swing a new tool into position, he pushes the handle away from him a quarter turn by exerting a steady pressure with his hand. The movement of the handle carries the plunger out of the cam recess and raises the handle and body on the column until the corrugations of the body clear those of the column base. The body can then be indexed freely, after which a steady pull on the handle will again lower the body and lock the turret without the necessity of pounding the handle.

Ample lubrication of all moving parts has been provided for. Provisions have also been made for preventing dirt from getting between the handle and body or chips from getting between the corrugated surfaces of the indexing mechanism.

Small Size Multiple-Disk Magnetic Clutch

A multiple-disk magnetic clutch which measures only 4 1/2 inches in diameter and has a torque capacity of 600 inch-pounds has been designed by the Magnetic Mfg. Co., Milwaukee, Wis. This unit is intended for use in built-in machine tool drives. One of the features is that the clutch is made without brushes, brush-holders, or collector rings. It operates on 30-watt direct current.

Magnetic Clutch for Built-in Machine Tool Drives

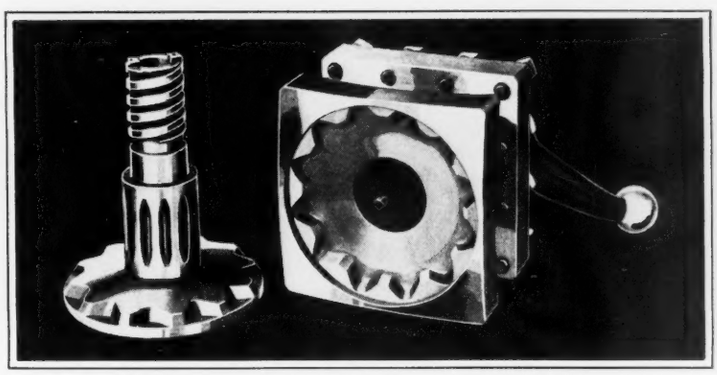
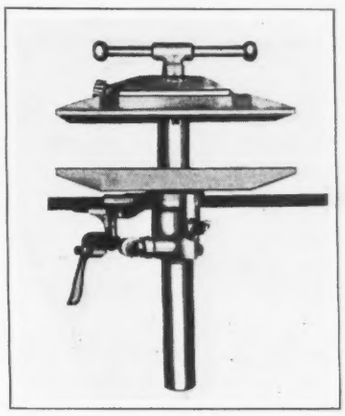


Fig. 2. Disassembled View of the Turret Body and Turret Column



A Patternmakers' Vise of Universal Type

Patternmakers' Universal Vise

An improved patternmakers' and woodworkers' vise which can be swiveled vertically and horizontally to bring the work into any position desired is shown in the illustration. When the work has been brought into the required position, the vise can be set to maintain that position until a new setting is to be made. This vise is a product of A. L. Metcalfe, 170 W. Killingsworth Ave., Portland, Ore. It is made in two sizes, with 7- by 16 3/4-inch jaws and 7- by 16-inch jaws. The larger vise weighs 89 pounds, and the smaller 82 pounds.

Adjustable Trammel Points

Our attention has been called to the fact that adjustable trammel points, such as described on page 694 of May MACHINERY, are available as a regular commercial product on the market. The L. S. Starrett Co., Athol, Mass., writes us that this company has long manufactured a complete line of trammel points, and that they can be bought in the market much cheaper than they could possibly be made up by a toolmaker or machinist for his own use. "Homemade" tools are usually expensive and not always satisfactory.

MEN IN THE INDUSTRY

R. E. W. HARRISON has resigned as sales engineering director of the Cincinnati Grinders, Inc. Mr. Harrison has been with this company since 1926, at which time he joined the organization as chief engineer. Prior to that time, he was with the Churchill Machine Tool Co. in England as assistant general works manager, and later as commercial manager. Mr. Harrison also terminates at this time his second year in office as chairman of the Cincinnati Section of the American Society of Mechanical Engineers, but continues his connection with the Society as secretary and member of the Executive Committee of the Machine Shop Practice Division, as well as his other activities in connection with engineering standardization projects.

GEORGE L. HURST, consulting mechanical engineer, is now handling, in the San Francisco territory, the sale of the Farrel-Sykes line of gears, speed reducers, gear drives, and gear-cutting machines, made by the Farrel-Birmingham Co., Inc., 377 Vulcan St., Buffalo, N. Y. Mr. Hurst is located at 785 Market St., San Francisco, Calif. J. R. BROWN has been appointed sales representative for the company, handling the sale of the Rafter patent press brake and other types of mechanical and hydraulic metal-working presses in the Middle West territory. Mr. Brown's headquarters are at the company's branch office, 2710 First Central Trust Bldg., Akron, Ohio.

JAMES S. WATSON, formerly vice-president in charge of the Link-Belt Co.'s Dodge Works, Indianapolis, Ind., has been appointed vice-president and general manager of both the Dodge and the Ewart Works in Indianapolis, succeeding GEORGE P. TORRENCE, who recently became president. FRANK S. O'NEIL, heretofore manager of the company's Ewart Works, has been appointed assistant general manager of both Indianapolis plants. C. WALTER SPALDING, who has been connected with the Ewart Works for a number of years, has been appointed sales manager of the Ewart plant products.

HALVOR OLSEN HEM, consulting engineer of the Toledo Scale Co., Toledo, Ohio, has been awarded the John Price Wetherwill medal by the Franklin Institute, Philadelphia, Pa., in consideration of "the ingenuity shown in perfecting scales of the pendulum type, improving their accuracy, reliability and sensitiveness, and for the application of these scales to specific purposes." Mr. Hem is well known in the industrial field. He has been granted over one hundred patents pertaining to scales and other types of industrial machinery. He joined the Toledo Scale Co. in 1915.

ROBERT KLAAS has been added to the staff of the Machinery Division of Divine Bros. Co., Utica, N. Y., manufacturer of flexible grinding, polishing, and buffing machinery. Mr. Klaas has been connected in various capacities with the polishing industry all his life. Previous to going with the Divine Bros. Co., he was with the Hammond Machinery Builders, Inc., of Kalamazoo, Mich.

KARL GROSS, an authority on lead burning, lead coating, and homogeneous lead work, has been added to the staff of the Northern Blower Co., West 65th St., south of Denison, Cleveland, Ohio. The company is now in a position to undertake any kind of lead work such as lead burning and coating, homogeneous lining for tanks, lead castings, etc.

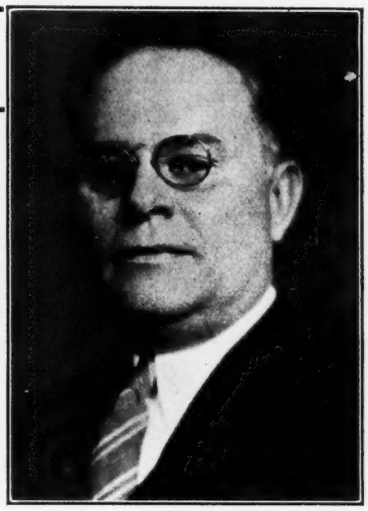
C. B. COLE, president of the Tool Equipment Sales Co., Chicago, Ill., was elected vice-president of the Service Tool Die & Mfg. Co., Chicago, at the annual meeting of the company. The other officers of the Service Tool Die & Mfg. Co. are: President, Carl Danielson; secretary, Christian Scheel; and treasurer, John G. Crotsley.

H. H. SNELL, sales engineer of 1400 Walnut St., Philadelphia, Pa., has been appointed eastern sales representative for the Universal Gear Corporation, Indianapolis, Ind., manufacturer of speed reducers, clutches, etc. Mr. Snell's territory will include all the Atlantic seaboard cities.

GEORGE F. BICKFORD, formerly with Henry Prentiss & Co., at Hartford, Conn., and prior to that with the Jones & Lamson Machine Co., Springfield, Vt., has joined the Triplex Machine Tool Corporation, 50 Church St., New York City, and will represent that company in the New England territory.

WINSLOW SAMPSON, for many years associated with SKF Industries, has just been appointed the Pittsburgh district manager of the Kron Co., Bridgeport, Conn., manufacturer of industrial scales. The Pittsburgh offices will be located at 302 Penn Ave.

GERARD SWOPE, president of the General Electric Co., Schenectady, N. Y., has been presented with the Gold Medal of the National Academy of Social Sciences in recognition of his constructive social services and his plans for dealing with unemployment.



Carl V. Dodge

CARL V. DODGE, manager of roll and steel casting sales of the United Engineering & Foundry Co., Pittsburgh, Pa., has been elected a vice-president of the company. Mr. Dodge has been identified with the production and sales of rolls and steel castings for twenty-six years, starting as a shipping clerk in the chilled roll foundry department.

R. H. SMITH, formerly manager of the Boston office of the Reliance Electric & Engineering Co., Cleveland, Ohio, has been promoted to the position of manager of the Development 'Engineering Department, with headquarters in Cleveland. C. E. ROBINSON has been advanced to fill Mr. Smith's former position.

H. J. RITTER, assistant secretary of Norma-Hoffmann Bearings Corporation, Stamford, Conn., has also been made sales manager of the organization. Mr. Ritter was formerly manager of the New York sales office of the concern.

C. E. ALLEN, commercial vice-president of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was recently elected a vice-president of the American Management Association for the year 1932-1933.

A. O. BREDEMERE, after eighteen years of association with the National Acme Co., Cleveland, Ohio, is terminating his duties as manager of the Detroit office, in order to devote his entire time to other interests.

F. T. CRANE, formerly district sales manager of the J. A. Fay & Egan Co., Cincinnati, Ohio, in the Chicago district, has been advanced to the position of sales manager.

G. P. BLACKISTON has been appointed sales promotion manager of the Kron Co., Bridgeport, Conn., manufacturer of industrial weighing scales.

NOW! . . . . a full line of

LUCAS

Horizontal Boring, Drilling and Milling Machines with

HIGH and LOW SPEED IN ONE SPINDLE

3-inch spindle 13½ to 1200 R. P. M.
4-inch spindle 9 to 1000 R. P. M.
5-inch spindle 7½ to 860 R. P. M.

EACH SPEED WITH

THE IDEAL DRIVE

V-Belt final drive for fast speeds.
Large spindle gears for slow speeds.

THE LUCAS MACHINE TOOL CO., Cleveland, O.

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. Andrews & George Co., Tokyo. Catmur Machine Tool Corp., Ltd., London, Eng. M. Kocian & G. Nedela, Prague. V. Lowener, Copenhagen, Oslo, Stockholm. Emanuele Mascherpa, Milan, Italy. R. S. Stokvis & Zonen, Rotterdam, Paris.

NEWS OF THE INDUSTRY

CHARLES L. JARVIS CO., Gildersleeve, Conn., manufacturer of tapping devices, quick-change chucks, stud setters, and screwdrivers, and the BIAX FLEXIBLE SHAFT CO., INC., 22-14 Fortieth Ave., Long Island City, N. Y., manufacturer of flexible shafting and flexible shaft machinery, have recently become merged. The Biax plant has been moved to Gildersleeve, Conn., and a service and sales department will be maintained at Long Island City. The business will be conducted under the name of Charles L. Jarvis Co., and the product will be designated Jarvis-Biax power appliances.

FARVAL CORPORATION, 3277 E. 80th St., Cleveland, Ohio, has recently acquired the manufacturing and sales rights to the Farval centralized system of lubrication, formerly manufactured by Lubrication Devices, Inc., Battle Creek, Mich. The officers of the company are Howard Dingle, president; W. W. Clark, vice-president; H. C. Robinson, treasurer; and A. C. Blair, secretary. A. J. Jennings, formerly vice-president of Lubrication Devices, Inc., is general sales manager of the Farval Corporation.

KIELEY & MUELLER, INC., 34 W. 13th St., New York City, manufacturer of steam, water, air, oil, and gas specialties, has recently purchased a new plant at 40 Paris St., Newark, N. J. The building covers a ground area of 135 by 185 feet, and provides 25,000 feet of floor space. Additional acreage has been secured adjoining the plant for expansion purposes. The company has been located at W. 13th St. for fifty-three years and will continue to maintain an office at this address for the present.

PIONEER ENGINEERING & MFG. CO., INC., 8316 Woodward Ave., Detroit, Mich., has made exclusive sales agency arrangements with the Banner Machine Tool & Supply Co., St. Louis, Mo., the Machinery Sales & Engineering Co., Indianapolis, Ind., and Walter J. Whatley, Syracuse, N. Y., to handle the sale of Rollway coolant and lubricant pumps, Pioneer multiple-spindle drill heads and electrochemical copper patterns in their respective territories.

PERMOLD CO., 6700 Grant Ave., Cleveland, Ohio, manufacturer of permanent-mold aluminum castings, has made some additions to its sales force in the East and in the Detroit territory. C. J. G. Fischer, 721 W. 7th St., Plainfield, N. J., now represents the Permold Co. along the Atlantic seaboard. Rex I. Lee and his associates, A. L. Edwards and E. D. Loomis, 212 Humber Bldg., Highland Park, Mich., are representing the company in the state of Michigan and in Toledo, Ohio.

HENRY B. NEWHALL CORPORATION announces that the New York office of the company and of its several divisions—the Diamond Expansion Bolt Co., the Newhall Chain Forge & Iron Co., and the New Jersey Foundry & Machine Co.—has been moved from 9 Park Place to 48 W. Broadway. The stockroom and warehouse, which have been located at 78-80 Murray St. for many years, have also been moved to the new quarters.

DARDELET THREADLOCK CORPORATION, 120 Broadway, New York City, has licensed the New England Screw Co. of Boston, Mass., to manufacture and sell bolts, nuts, and screws with the Dardelet self-locking thread. The Parker & Harper Mfg. Co., of Worcester, Mass., has been licensed to manufacture and sell screw machine products with the Dardelet self-locking thread.

J. A. FAY & EGAN CO., Cincinnati, Ohio, manufacturer of woodworking machinery, announces that the New York office of the company has been moved to the Nelson Tower Bldg., 205 W. 34th St., New York City. H. C. Whitlock is regional manager. The Boston office has been moved back to 265 Purchase St. William C. Chesworth is local manager in Boston.

DANLY MACHINE SPECIALTIES, INC., 2112 S. 52nd Ave., Chicago, Ill., has recently added a torch cutting and welding department to facilitate the handling of special die sets, die-shoes, bolster plates, stripper plates, and similar die parts. This department is also equipped to cut and fabricate steel-plate shapes and various welded steel-plate units for the trade.

POOLE FOUNDRY & MACHINE CO., has taken over the former business and plant of the POOLE ENGINEERING & MACHINE CO., Woodberry, Baltimore, Md. The concern will continue to manufacture flexible couplings, reduction gears, machine molded and cut gears, gray iron and semi-steel castings, and will engage in building special machinery.

ADAMS GREASE GUN CORPORATION, 239 Fourth Ave., New York City, announces that the company's patent infringement controversy with the Alemite Corporation, Chicago, Ill., has been settled, and that the Adams Corporation has been licensed to continue the manufacture and sale of its products under the Alemite patents.

HOMESTEAD VALVE MFG. CO., INC., Coraopolis, Pa., has appointed the Lietz Engineering Co., 2354 Lincoln Ave., Chicago, Ill., exclusive representative in the Chicago district for the sale of all Homestead products, including quarter-turn valves, protected-seat hydraulic operating valves, and vapor spray cleaning machines.

RELIANCE ELECTRIC & ENGINEERING CO., 1042 Ivanhoe Road, Cleveland, Ohio, has established a sales branch at Grand Rapids, Mich. Marshall T. Ball will be in charge of the new branch. His headquarters will be at 208 Fuller Ave., S.E., Grand Rapids, and he will cover northeastern Michigan.

BURKE ELECTRIC CO., Erie, Pa., manufacturer of motors, generators, and electric welders, has appointed George Kuehnle, Jr., general distributor for the company's products in the Cincinnati district. Mr. Kuehnle is located at 1011 First National Bank Bldg., Cincinnati.

AMERICAN CABLE CO., INC., 230 Park Ave., New York City, announces that the Macwhyte Co., Kenosha, Wis., has recently been added to the list of wire rope manufacturers licensed to manufacture preformed wire rope under the American Cable Co.'s patents.

SOUTH BEND LATHE WORKS, 774 E. Madison St., South Bend, Ind., announce a change of address of their Chicago distributor, the C. B. Burns Machinery Co., from 541 Washington Blvd. to larger quarters at 26-28 N. Clinton St.

E. A. MCCALLUM, representing Roots-Connersville-Wilbraham, Connersville, Ind., manufacturer of blowers, pumps, and meters, has removed from Los Angeles to San Francisco, and is now located in Room 620, Hearst Building.

OSBORN MFG. CO., 5401 Hamilton Ave., Cleveland, Ohio, has recently added to its products a complete line of overhead materials-handling equipment known as Osborn tramrail systems. The equipment is built for capacities up to 3 tons.

ROBBINS & MYERS SALES, INC., Springfield, Ohio, has appointed the John E. Livingstone Co., 2-246 General Motors Bldg., Detroit, Mich., sales agent for the hoist and crane division of the company, covering the Detroit territory.

GEOMETRIC STAMPING CO., Cleveland, Ohio, manufacturer of metal stampings, has appointed Dudley H. Smith, 221 E. 20th St., Chicago, Ill., representative in the Chicago district.

LINCOLN ELECTRIC CO., Cleveland, Ohio, has appointed the Great Northern Tool & Supply Co., Billings, Mont., distributor for Lincoln products in Montana and Wyoming.

POLLARD BROS. MFG. CO., Chicago, Ill., manufacturer of steel factory equipment, is moving the first of June to larger quarters at 4444-4446 N. Knox Ave.

A 7-in. AJAX MACHINE FORGING

by the
AMERICAN
FORGE
COMPANY
Chicago, Ill.

•

THIS 70-pound tractor flange is a fine example of present-day progress in upset forging.

It is forged without waste in flash or tong hold by the American Forge Company on one of their seven *AJAX 7-in. Forging Machines.* In shape and dimensions it conforms closely to the finished piece, limiting waste in machining to a minimum.

In the production of large forgings especially, great economies can be effected in both material and machining through the use of *AJAX Heavy Duty Upsetting Forging Machines.*

THE AJAX MANUFACTURING CO.
EUCLID BRANCH P. O., CLEVELAND, O.
Chicago Office: 621 Marquette Bldg.

AJAX

Coming Events

JUNE 3-4—Ninth annual convention of the National Association of Foremen to be held at Mansfield, Ohio. E. H. Tingley, secretary, Refiners Bldg., Dayton, Ohio.

JUNE 6-8—Sixth National Technical Aeronautic Meeting to be held at the Hotel Statler, Buffalo, N. Y., under the auspices of the Aeronautic Division of the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

JUNE 12-17—Spring meeting of the Society of Automotive Engineers, at White Sulphur Springs, W. Va. John A. C. Warner, secretary, 29 W. 39th St., New York City.

JUNE 20-24—Annual meeting of the American Society for Testing Materials at Atlantic City, N. J. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

JUNE 23-24—Annual meeting of the Mechanical Division of the American Railway Association in Chicago, Ill.; headquarters, Congress Hotel. This will be strictly a business meeting with no exhibits. Secretary, V. R. Hawthorne, 59 E. Van Buren St., Chicago, Ill.

JUNE 27-30—Semi-annual meeting of the American Society of Mechanical Engineers, jointly with the Canadian Institute of Engineers, at the Bigwin Hotel, Lake of Bays, Highlands of Ontario, Canada. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

OCTOBER 3-7—National Metal Congress, Buffalo, N. Y., sponsored by the American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio, with the cooperation of the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Welding Society, and the Wire Association.

OCTOBER 3-8—Fourteenth annual National Metal Exposition to be held in the 174th Regiment Armory, Buffalo, N. Y. W. H. Eisenman, secretary, American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio.

New Books

RATIONALIZED SALES TRAINING LEADS TO INCREASED SALES. By P. W. Combs, Sr. 11 pages, 5 by 7½ inches. Published by the Read Printing Co., 50-60 Vandam St., New York City.

The author of this book, who is associate professor of the Department of Marketing at New York University and who also acts as counselor on sales and advertising methods, has presented in this booklet, interestingly and concisely, the reasons for systematic sales training. Much sound advice on specific methods that make for more effective selling are included.

* * *

Close and accurate control of the frequency of current interruption in line welding and an increase in the speed of interruption up to 1800 per minute are among the advantages of the new type of thyratron tube timing control announced by the General Electric Co. The new control replaces mechanical interrupters. The equipment operates in synchronism with the alternating current supply of the welding machine.

Obituaries

FRANKLIN FRICK LANDIS, one of the founders of the Landis Tool Co., Waynesboro, Pa., died Monday, May 2, at the age of eighty-seven years. The death of Mr. Landis marks the passing of a pioneer in the machine tool industry. He made his first commercial grinding machine in 1872 at Lancaster, Pa. This machine did external as well as internal grinding, embodying the basic principles upon which later grinding machines were designed.

It was not until 1889, however, that Mr. Landis placed on the market a commercial grinding machine. At that time, together with his brother A. B. Landis, he began to manufacture grinding machines in Waynesboro under the firm name of Landis Brothers. The concern was incorporated as the Landis Tool Co. in 1897. In cooperation with his brother, he also developed a bolt cutter employing a tangential threading die. This brought about the organization of the Landis Machine Co. of Waynesboro, Pa.

While Mr. Landis, during recent years, was not actively connected with the companies bearing his name, his interest in the mechanical arts continued right up to his last brief illness. He held many patents on products such as electric clocks, automobile shock absorbers, concrete block machinery, etc. He is survived by three daughters and one son.

EDWARD BOWHALL, of the Wolverine Pattern Works, Detroit, Mich., died on April 25 at the age of thirty-nine. Mr. Bowhall had been identified with the activities of the company for seventeen years, and was particularly well known in the automotive industries.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MACHINERY, published monthly at New York, N. Y., for April 1, 1932.

State of New York } ss.
County of New York }

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the treasurer of The Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Robert B. Luchars, 140-148 Lafayette St., New York; Edgar A. Becker, 140-148 Lafayette St., New York; and Erik Oberg, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press, 140-148 Lafayette St., New York; Estate of Alexander Luchars, 140-148 Lafayette St., New York; Louis Pelletier, 140-148 Lafayette St., New York; Erik Oberg, 140-148 Lafayette St., New York; Robert B. Luchars, 140-148 Lafayette St., New York; Edgar A. Becker, 140-148 Lafayette St., New York; Laura A. Brownell, 140-148 Lafayette St., New York; Franklin D. Jones, 140-148 Lafayette St., New York; Elizabeth Y. Urban, 163 Western Drive, Longmeadow, Mass.; and Helen L. Ketchum, Atlantic Ave., Cohasset, Mass.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer

Sworn to and subscribed before me this 21st day of March, 1932

CHARLES P. ABEL,
Notary Public, Kings County No. 210
(SEAL) Kings Register No. 3011
New York County No. 15, New York Register No. 3-A-6
(My commission expires March 30, 1933)